A Summary of Reported Estimates of Heritabilities and of Genetic and Phenotypic Correlations For Traits of Chickens

Agriculture Handbook No. 363

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INTRODUCTION

Definitions, methods of estimation, and biases associated with heritability estimates have been presented in considerable detail by Lush (*112*), Lerner (*105*), Dickerson (*32*), Falconer (*37*),[1] and others. The methods that have been most commonly used to estimate the heritabilities of various traits observed in chickens are:

(1) Paternal half-sib correlation [$4\hat{\sigma}_s^2/\hat{\sigma}_p^2$],
(2) Maternal half-sib correlation [$4\hat{\sigma}_d^2/\hat{\sigma}_p^2$],
(3) Full-sib correlation [$2\,(\hat{\sigma}_s^2+\hat{\sigma}_d^2)/\hat{\sigma}_p^2$],
(4) Parent-offspring regression [$\hat{\sigma}_{op}/\hat{\sigma}_p^2$], and
(5) Realized heritability [R/S].

Where:

$\hat{\sigma}_s^2$ and $\hat{\sigma}_d^2$ are the estimated sire and dam components of variance, respectively,
$\hat{\sigma}_p^2$ is the phenotypic variance,
$\hat{\sigma}_{op}$ is the parent-offspring covariance,
R is the estimate response to selection, and
S is the selection differential.

The estimation methods that have been used by most researchers have been determined by the mating system of the chickens, the trait of interest, or in some cases, unfortunately, the availability of computer programs.

The hierarchal mating system has been the most commonly used method of propagation in poultry breeding studies. Thus, a major part of the heritability estimates reported in the literature have been obtained by methods (1), (2), and (3). Estimates based on any of these three methods will be biased upward if epistatic variance is important. In any case (1) is expected to be less biased than (2) because of the confounding of maternal effects or dominance variance with the dam component of variance in the hierarchal mating structure. Obviously, (3) is expected to be intermediate between (1) and (2) in value and amount of bias.

The least biased heritability estimates and the best estimates of effective heritability are probably obtained from (4) and (5) although (5) has been little used for the estimation of heritability of traits of chickens.

Heritability estimates are of value because they are an estimate of the proportion of phenotypic variance that is additively genetic and thus serves as an indication of the rate of improvement that might be realized by selection. Perhaps more importantly, the estimates are of value in making decisions regarding the type of mating system that will allow the greatest or most rapid improvement, or both. For example, if a trait is highly heritable, the most economical and rapid improvement will likely be made through mass selection. If a trait is lowly heritable, some form of family selection or progeny testing, or both, will likely be more effective than mass selection.

Although heritability estimates permit one to predict the amount of gain expected from a given amount of selection, the accuracy of prediction is a direct function of the accuracy of the heritability estimate. For this reason an estimate of the heritability of a trait in one population of chickens may or may not be a reliable parameter estimate to use for prediction of gain due to selection in a genetically different population. For any trait an average of heritability estimates from many populations is useful only to categorize expected gain in another population as large, medium, or small. Thus, if one is interested in predicting genetic gain in a specific population as accurately as possible, then he must estimate the heritability from the population for which prediction is to be made. It seems apparent that heritability estimates as such are of little value except as they contribute to an average that is itself useful only to categorize heritability as high, low, or medium for various genetic types of populations; for example, light breeds or heavy breeds.

[1] Italic numbers refer to References, page 39.

Early attempts to determine the genetic relationships among traits were restricted by lack of appropriate statistical methods for separating the genetic and environmental portions of phenotypic correlations. In 1943 Hazel (*67*) developed a method of calculating the genetic correlation among traits. Since that time, many estimates of the genetic correlations among various traits of poultry have been published. Since the genetic correlation is a function of the covariance and respective variances of two traits, it is subject to the same sources of bias mentioned earlier with regard to variance component estimation.

Genetic correlation estimates quantitate the extent to which two traits are controlled by the same genes. The estimates permit one to predict the correlated response of one trait to selection for a different trait. However, as clearly indicated by the work of Bohren, Hill, and Robertson (*13*), prediction of correlated responses to selection beyond a single generation is likely to be highly inaccurate without some prior knowledge of the magnitude and composition of the genetic covariance. This finding implies that highly accurate estimates of the genetic correlation within a population are necessary to accurately predict correlated responses even for a single generation. Thus it seems logical to conclude that genetic correlation estimates as such are of little value except as they may be used in the population in which they are estimated.

An average of genetic correlation estimates from different populations is probably of value only as an indicator of the expected genetic correlation between two traits. It should be kept in mind that, depending on the trait, the individual estimates can vary from large negative to large positive in different populations or even within the same population during different generations of selection.

The summaries contained herein will serve as a reasonably complete review of the literature to the present time. It is virtually impossible to summarize all estimates of heritabilities or genetic correlations because many have been published only in theses, progress reports, or other publications that are not readily accessible. A request for references was addressed to at least one researcher at all experiment stations throughout the United States and a number of references were obtained from them. Many of the publications reviewed did not report specific estimates but rather indicated the approximate magnitude of the estimate. These reports were not used.

METHODS OF SUMMARIZATION

The heritability estimates as reported in the literature have been listed by traits in tabular form indicating the method of estimation, the number of sires and dams, the breed or cross, and sex when pertinent. When two or more estimates were obtained by the same method, in the same population, the estimates were averaged unless standard errors were reported. If standard errors were reported, all estimates and the standard errors were tabulated. Reported estimates of genetic and phenotypic correlations were averaged and the average value is presented in tabular form. When pertinent, an average of tabulated values of heritabilities was calculated and included in the tables; for example, average of reported estimates of the heritability of 8-week weight of males.

Heritability estimates are summarized in tables 1, 2, 3, and 4. Genetic and phenotypic correlations are summarized in table 5. Definitions and abbreviations of terms used in the discussion of the summaries and in the tables are as follows:

Trait	
Feed consumption	Pounds of feed consumed.
Feed efficiency	Pounds of feed per pound of gain.
Survivor production	Number of eggs laid by surviving hens.
First n months or days.	Number of eggs laid in the first n months or days after sexual maturity (usually early fall).
S.M.	Sexual maturity.
To December 31 or some other time.	Number of eggs laid or rate of production from sexual maturity to that time.
Annual production	Number of eggs laid in 1 year.
Hen housed production.	Number of eggs laid by all birds housed.
Egg mass	Total weight of eggs.
Early egg weight	Egg weight taken during the first 2 to 3 months of lay.
Mature egg weight	Egg weight taken after 3 months of lay.
Hen day production	Production estimate based on number of hen days.
LH	Leuteotropic hormone.
FSH	Follicle stimulating hormone.

Breed

A	Australorp.
AC	Athens Canadian randombred.
ARB	Athens randombred.
BL	Brown Leghorn.
BlC	Black Castelana.
BR	Barred Rock.
C	Combined sexes.
Cross	Undesignated cross.
D	Durham.
F	Fayoumi.
G	Gatinaise.
Heavy	Undesignated heavy breed.
Inbred	A strain specified as inbred.
J	Jungle fowl.
Light	Undesignated light weight breed.
Mix	Several strains or breeds.
Nag	Nagoya.
NH	New Hampshire.
Ot	Ottawa control.
RIR	Rhode Island Red.
S	Sussex.
SO	Silver Oklabar.
Syn	Synthetic line.
WC	White Cornish.
WG	White Gold.
WL	White Leghorn.
WR	White Rock.
WW	White Wyandotte.
X's	Refers to crosses; for example, WLX's means several White Leghorn crosses.

Breed—Continued

's	Denotes plural; for example, WL's means White Leghorn lines.
*	Indicates an unselected line.
—— (in stub column of table).	Indicates breed or cross not reported.
— (in field of table).	Indicates no data available.

Heritability

S	Refers to estimation by paternal half-sib correlation.
D	Refers to estimation by maternal half-sib correlation.
S+D	Refers to estimation by full-sib correlation.
b_{op}	Refers to estimation by parent-offspring regression.
Real.	Refers to realized heritability.

Degree of Freedom

S	Refers to approximate degrees of freedom for sires.
D	Refers to approximate degrees of freedom for dams.
Ref.	Refers to the number of the reference in the list of references.

DISCUSSION OF SUMMARIES

Heritability Estimates

Table 1 is a summary of reported heritability estimates of body weight, weight gain, feed consumption, feed efficiency, conformation, market quality traits, and pigmentation.

There are few reported estimates of the heritability of body weight before 4 weeks of age. Although there is wide variation in some of the individual reports, the averages of estimates indicate that if there are any differences in the heritability of body weight at 4 weeks of age or later, they are small. There is no strong evidence for a difference in sexes or in light and heavy breeds as far as the magnitude of the heritability is concerned. There is, however, a strong indication of either maternal or dominance effects, or both, up to maturity. The presence of either or both of these effects is evidenced by the rather consistently higher average estimates from the maternal half-sib correlations as opposed to paternal half-sib correlations for body weights before pullet age. Although some individual estimates indicate the possible existence of either important maternal or dominance effects, or both, for pullet and mature body weights, the averages of estimates indicate no importance of these effects.

Weight gain heritability appears to be similar in magnitude to body weight heritability (0.35 to 0.53) based on averages of three reports. Estimates by a single investigator indicate that feed consumption is highly heritable (greater than 0.50). The heritability of feed efficiency is much lower (0.39 or less). The heritability of feathering traits, breast angle, body depth, keel length, dressing percent, and shank pigmentation apparently fall within the approximate range of 0.25

to 0.40. Heritability estimates of shank diameter and weight/shank length, based on a single report, are about 0.60 and 0.50, respectively.

Table 1 summaries indicate that there have been sufficient reports of the heritability of body weights from 4 weeks of age through maturity to provide a reasonable expectation for this parameter. For all other traits reported in table 1 there are too few reports to serve as reliable estimates of the heritabilities, but these traits all appear to be quite highly heritable (in the approximate range of 0.25 to 0.60).

TABLE 1.—*Reported heritability estimates of body weight, weight gain, feed consumption, feed efficiency, conformation, market quality traits, and pigmentation, by age, breed, and sex of chickens*

Trait, age, and breed of chicken	Sex	Heritability estimate					Degree of freedom		Ref.
		S	D	S+D	b_{OD}	Real.	S	D	
BODY WEIGHT									
2-week embryo: Meat cross	—	0.18	—	—	—	—	40	320	*201*
2 weeks:									
NH	♂	.05	—	0.40	—	—	8	66	*35*
NH	♀	.01	—	.44	—	—	8	66	*35*
3 weeks: RIR	C	—	—	.31	—	—	24	71	*126*
4 weeks:									
WL	♂	.29±.63	—	—	—	—	40	600	*10*
WL	♂	.21±.44	—	—	—	—	40	600	*10*
WR	♂	—	—	.47	—	—	64	380	*167*
WR	♂	—	—	.43	—	—	32	192	*168*
NH	♂	.75	0.74	—	—	—	56	218	*183*
NH	♂	.58	.45	—	—	—	25	125	*43*
NH	♂	.54	.32	—	—	—	25	125	*43*
DXNH	♂	.19	.72	—	—	—	45	400	*138*
DXNH	♂	.20	.81	—	—	—	45	400	*138*
Mix	♂	.66	—	—	—	—	—	—	*74*
Average	—	.43	.61	.45			—	—	—
WR	♀	—	—	.47	—	—	64	380	*167*
WR	♀	—	—	.53	—	—	32	192	*168*
NH	♀	.53	.96	—	—	—	56	218	*183*
NH	♀	.19	.98	—	—	—	25	125	*43*
NH	♀	.35	1.01	—	—	—	25	125	*43*
DXNH	♀	.31	.81	—	—	—	45	400	*138*
DXNH	♀	.20	.99	—	—	—	45	400	*138*
Mix	♀	.25	—	—	—	—	—	—	*74*
Average	—	.31	.95	.50	—	—	—	—	—
6 weeks:									
NH	♂	.09	—	32	—	—	8	66	*35*
NH	♂	.50	.83	—	—	—	56	218	*183*
Ot*	♂	.39±.07	.92±.07	—	0.51±.03	—	395	1,128	*129*
Ot*	♂	—	—	.74	—	—	240	675	*130*
DXNH	♂	.24	.72	—	—	—	45	400	*138*
DXNH	♂	.28	.78	—	—	—	45	400	*138*
Average	—	.30	.81	.53	.51	—	—	—	—
NH	♀	.65	1.02	—	—	—	56	218	*183*
NH	♀	.18	—	.32	—	—	8	66	*35*
Ot*	♀	.46±.07	.61±.08	—	.45±.03	—	395	1,128	*129*
Ot*	♀	—	—	.64	—	—	240	675	*130*
DXNH	♀	.36	.65	—	—	—	45	400	*138*
DXNH	♀	.27	.84	—	—	—	45	400	*138*
Average	—	.38	.78	.48	.45	—	—	—	—

TABLE 1.—*Reported heritability estimate of body weight, weight gain, feed consumption, feed efficiency, conformation, market quality traits, and pigmentation, by age, breed, and sex of chickens*—Continued

Trait, age, and breed of chicken	Sex	Heritability estimate					Degree of freedom		Ref.
		S	D	S+D	b_{OD}	Real.	S	D	
BODY WEIGHT—Con.									
6 weeks—Continued									
NH	C	.51	.98	—	—	—	56	218	*183*
RIR	C	—	—	.29	—	—	24	71	*126*
Ot*	C	.40±.05	.72±.05	—	.46±.02	—	395	1,128	*129*
Average	—	.46	.85	.29	.46	—	—	—	—
8 weeks:									
WR	♂	—	—	.75	—	—	—	—	*9*
WR	♂	—	—	.63	—	—	—	—	*9*
WR	♂	—	—	—	—	0.31	32	192	*164*
WR	♂	.64	.34	.49	—	—	36	161	*171*
WR	♂	.29	.60	.44	.22	.30	64	380	*165*
WR	♂	—	—	.26	—	—	64	380	*167*
WR	♂	—	—	—	—	.31	32	192	*168*
NH	♂	.25	.13	—	.35±.09	—	25	125	*43*
NH	♂	.01	.54	—	.05±.22	—	25	125	*43*
NH	♂	.07	—	.32	—	—	8	66	*35*
NH	♂	.26	.34	—	—	—	106	—	*53*
NH	♂	.28	.15	—	—	—	106	—	*53*
NH	♂	.55	.86	—	—	—	56	218	*183*
Syn	♂	.11±.01	1.07±.25	.63±.10	—	—	109	756	*41*
Syn	♂	.48	.52	—	—	—	—	—	*52*
Syn	♂	.36	.25	—	—	—	—	—	*52*
Syn	♂	.24±.07	—	—	.37±.04	—	115	450	*97*
Syn	♂	.36±.08	—	—	.33±.03	—	120	405	*97*
Syn	♂	.39	.52	.45	—	—	44	428	*202*
DXNH	♂	.20	.65	—	—	—	45	400	*138*
DXNH	♂	.65	.57	—	—	—	45	400	*138*
Mix	♂	.69	—	—	—	—	—	—	*74*
——	♂	.47	.85	—	—	—	160	160	*83*
——	♂	.32	.16	—	—	—	160	160	*83*
——	♂	.88	—	—	—	—	20	164	*15*
Average	—	.38	.50	.50	.26	.31	—	—	—
WL	♀	.52±.05	—	—	—	—	188	728	*203*
WL	♀	.26±.31	.69±.39	—	—	—	100	500	*207*
WL	♀	.48±.09	—	—	—	—	684	2,364	*96*
WL	♀	.43±.10	—	—	—	—	684	2,364	*96*
WL	♀	.66±.93	—	—	—	—	40	600	*9*
WL	♀	.41±.68	—	—	—	—	40	600	*9*
WL	♀	.29	.69	—	—	—	300	1,500	*94*
WL*	♀	.22	.35	—	—	—	60	260	*186*
WR	♀	—	—	.10	—	—	—	—	*153*
WR	♀	—	—	.82	—	—	—	—	*10*
WR's	♀	—	—	.42	—	—	71	318	*205*
WR	♀	.12	.58	.35	.36	.27	64	380	*165*
WR	♀	—	—	.63	—	—	—	—	*10*
WR	♀	—	—	.14	—	—	64	380	*167*
WR	♀	—	—	—	—	.27	32	192	*168*
WW	♀	.25±.09	.77±.10	.51±.12	—	—	46	232	*62*
NH	♀	.21	.36	—	—	—	8	66	*35*
NH	♀	.06	.95	—	.65±.14	—	25	125	*43*
NH	♀	.16	.03	—	.23±.12	—	25	125	*43*
NH	♀	—	—	.33	—	—	9	48	*79*
NH	♀	.35	.63	—	—	—	128	—	*53*
NH	♀	.15	.63	—	—	—	128	—	*53*
NH	♀	.88	.69	—	—	—	56	218	*183*
RIR	♀	.34±.55	.28±.66	—	—	—	100	500	*207*
RIR*	♀	.50±.09	—	—	—	—	273	1,825	*95*
BR	♀	—	—	.33	—	—	18	85	*79*
Syn	♀	.15±.04	.69±.13	.39±.05	—	—	109	769	*41*
Syn	♀	—	—	.49	—	—	75	500	*85*

TABLE 1.—*Reported heritability estimates of body weight, weight gain, feed consumption, feed efficiency, conformation, market quality traits, and pigmentation, by age, breed, and sex of chickens*—Continued

Trait, age, and breed of chicken	Sex	Heritability estimate					Degree of freedom		Ref.
		S	D	S+D	b_{OD}	Real.	S	D	
BODY WEIGHT—Con.									
8 weeks—Continued									
Syn	♀	.37	.53	.42	—	—	44	428	*202*
Syn	♀	.24±.06	—	—	.33±.04	—	110	440	*97*
Syn	♀	.31±.09	—	—	.22±.04	—	110	360	*97*
Mix	♀	.51	—	—	—	—	—	—	*74*
Mix	♀	—	—	—	.31	—	193	980	*117*
Mix	♀	—	—	.46	.40	—	159	609	*197*
DXNH	♀	.65	.57	—	—	—	45	400	*138*
DXNH	♀	.68	.94	—	—	—	45	400	*138*
RIRXWL	♀	.95±.34	.64±.35	—	—	—	100	500	*207*
WLXRIR	♀	.20±.34	.89±.40	—	—	—	100	500	*207*
——	♀	.55	—	—	—	—	20	164	*15*
Average	—	.39	.61	.42	.36	.27	—	—	—
F	C	.67	.84	.76	—	—	70	488	*5*
WR	C	.21	.58	.39	.29	.29	64	380	*165*
WR	C	—	—	.20	—	—	64	380	*167*
NH	C	—	—	.34	—	—	—	—	*34*
NH	C	.49±.13	—	—	—	—	—	—	*122*
NH	C	.36±.22	—	—	—	—	—	—	*122*
NH	C	.64	.85	—	—	—	56	218	*183*
Mix	C	.35	—	—	—	—	59	457	*45*
Cross	C	—	—	1.25	—	—	220	220	*176*
Average	—	.45	.76	.59	.29	.29	—	—	—
9 weeks:									
WR	♂	—	—	.63	—	—	50	109	*172*
NH	♂	.17	.45	.31	.35±.17	—	12	120	*48*
NH	♂	.16	.55	.35	.28±.04	—	15	156	*51*
Ot*	♂	—	—	.73	—	—	240	675	*130*
Ot*	♂	.40±.06	.81±.08	—	.56±.03	—	395	1,128	*129*
SO	♂	.54	.72	.63	.49±.17	—	14	110	*48*
SO	♂	.63	.49	.56	.20±.08	—	10	98	*51*
Average	—	.38	.60	.54	.38	—	—	—	—
NH	♀	.13	.96	.54	.55±.13	—	12	120	*48*
NH	♀	.23	.65	.44	.36±.04	—	15	158	*51*
Ot*	♀	—	—	.58	—	—	240	675	*130*
Ot*	♀	.44±.06	.49±.07	—	.49±.03	—	395	1,128	*129*
SO	♀	.38	.45	.41	.47±.16	—	14	110	*48*
SO	♀	.56	.42	.49	.20±.07	—	10	96	*51*
Average	—	.35	.59	.49	.41	—	—	—	—
NH	C	.28	.65	.48	.22±.04	—	10	129	*51*
NH	C	.28	.52	.40	.49±.03	—	12	131	*51*
NH	C	.08	.74	.41	.34±.03	—	12	140	*51*
RIR	C	—	—	.27	—	—	24	71	*126*
Ot*	C	.40±.05	.62±.05	—	.52±.02	—	395	1,128	*129*
NH	C	.30	.51	.41	.34±.03	—	8	87	*51*
NH	C	.41	.80	.60	.50±.06	—	8	67	*51*
NH	C	.45	.51	.48	.37±.05	—	9	86	*51*
Average	—	.31	.62	.44	.40	—	—	—	—
10 weeks:									
WW	♀	.36	.91	.63	—	—	8	545	*206*
NH	♀	.24	—	.47	—	—	8	66	*35*
NH	♀	.94	.60	—	—	—	56	218	*183*
Mix	♀	—	—	.46	.33	—	—	—	*101*
Average	—	.51	.76	.52	.33	—	—	—	—

TABLE 1.—*Reported heritability estimates of body weight, weight gain, feed consumption, feed efficiency, conformation, market quality traits, and pigmentation, by age, breed, and sex of chickens*—Continued

Trait, age, and breed of chicken	Sex	Heritability estimate					Degree of freedom		Ref.
		S	D	S+D	b_{OD}	Real.	S	D	
BODY WEIGHT—Con.									
10 weeks—Continued									
NH	♂	.09	—	.33	—	—	8	66	*35*
NH	♂	.45	.78	—	—	—	56	218	*183*
Average	—	.27	.78	.33	—	—	—	—	—
NH	C	.62	.29	.45	—	—	10	100	*21*
NH	C	.56	.81	—	—	—	56	218	*183*
RIR	C	.29	—	.38	.15±.08	—	18	140	*149*
SO	C	.50	.17	.34	—	—	10	100	*21*
NHXSO	C	.45	—	—	—	—	82	440	*19*
NHXSO	C	.65	.31	.48	—	—	10	100	*21*
SOXNH	C	.69	.35	.52	—	—	10	100	*21*
Average	—	.54	.39	.43	.15		—	—	—
12 weeks:									
WL	♀	.43±.10	.57±.08	.50	—	—	105	300	*23*
WL	♀	.73±.13	.58±.09	.66	—	—	105	300	*23*
WL	♀	—	—	—	—	.44	80	305	*36*
WL	♀	—	—	—	.35	—	—	—	*155*
B1C	♀	—	—	—	.34	—	—	—	*155*
F	♀	—	—	—	.54	—	—	—	*155*
Average	—	.58	.58	.58	.41	.44	—	—	—
NH	C	.38	—	—	—	—	8	85	*3*
NH	C	.42	.60	.51	—	—	8	29	*106*
RIR	C	—	—	.31	—	—	24	71	*126*
SO	C	—	—	—	—	.34±.03	160	1,150	*124*
SO	C	—	—	—	—	.07±.05	160	1,150	*124*
SO	C	—	—	—	—	.45±.03	240	1,725	*123*
SO	C	—	—	—	—	.17±.05	240	1,725	*123*
Average	—	.40	.60	.41	—	.26	—	—	—
16 weeks: Heavy Cross	C	—	—	.47	—	—	192	192	*176*
21 weeks: Ot*	♂	—	—	.61	—	—	240	675	*130*
24 weeks:									
Heavy Cross	C	—	—	.52	—	—	144	144	*176*
Pullet (light):									
WL	♀	.67±.03	—	—	—	—	436	1,897	*203*
WL	♀	.40±.09	.57±.08	.48	—	—	105	300	*23*
WL	♀	.69±.13	.56±.09	.63	—	—	105	300	*23*
WL	♀	.28±.08	.64±.09	.46	—	—	105	300	*23*
WL	♀	.74±.13	.57±.09	.65	—	—	105	300	*23*
WL	♀	—	—	.48±.06	—	—	230	2,270	*40*
WL	♀	—	—	—	—	.43±.04	115	1,135	*40*
WL*	♀	.32	.52	—	—	—	168	559	*68*
WL*	♀	.48	.89	—	—	—	300	1,500	*94*
WL*	♀	.86±.11	—	—	—	—	340	1,200	*96*
WL*	♀	.41±.09	—	—	—	—	340	1,200	*96*
WL	♀	.86±.34	.17±.38	—	—	—	100	500	*207*
WLX's	♀	.29	—	.41	—	—	464	3,036	*31*
WLX's	♀	.61	—	.43	—	—	501	4,769	*73*
BL	♀	.37±.09	.34±.14	—	—	—	65	660	*63*
BLXS	♀	.71±.13	.45±.12	—	—	—	65	660	*63*
SXBL	♀	.55±.12	.74±.13	—	—	—	65	660	*63*
WLXRIR	♀	.69±.31	.06±.30	—	—	—	100	500	*207*
RIRXWL	♀	.78±.32	.30±.34	—	—	—	100	500	*207*
Mix	♀	—	—	.31	.18	—	159	609	*197*
Mix	♀	—	—	.43	.32	—	—	—	*101*
Average	—	.57	.48	.48	.25	.43	—	—	—

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TABLE 1.—*Reported heritability estimates of body weight, weight gain, feed consumption, feed efficiency, conformation, market quality traits, and pigmentation, by age, breed, and sex of chickens*—Continued

Trait, age, and breed of chicken	Sex	Heritability estimate					Degree of freedom		Ref.
		S	D	S+D	b_{OD}	Real.	S	D	
BODY WEIGHT—Con.									
24 weeks—Continued									
Pullet (heavy):									
WR	♀	—	—	—	—	.41	64	384	*80*
WR	♀	—	—	.44	—	—	64	380	*167*
WR	♀	—	—	.43	—	—	64	380	*167*
WR	♀	—	—	.46	—	—	32	192	*168*
WR	♀	—	—	.38	—	.41	64	384	*80*
NH	♀	.35	.47	.41	.34±.04	—	10	129	*51*
NH	♀	.51	.21	.36	.39±.04	—	12	131	*51*
NH	♀	.47	.59	.53	.33±.06	—	12	140	*51*
NH	♀	.58	.27	.39	.40±.04	—	15	158	*51*
RIR	♀	.68±.08	—	—	—	—	547	3,138	*95*
RIR	♀	.85	—	.71	.72±.11	—	18	140	*149*
RIR	♀	.63±.04	.35±.41	—	—	—	100	500	*207*
WW	♀	.52±.13	.70±.10	.61±.07	—	—	46	232	*62*
SO	♀	.43	.90	.67	.46±.04	—	8	87	*51*
SO	♀	.34	.81	.58	.43±.08	—	8	67	*51*
SO	♀	.57	.41	.49	.47±.04	—	9	86	*51*
SO	♀	.45	.59	.52	.40±.04	—	10	96	*51*
Ot*	♀	—	—	.64	—	—	240	675	*130*
SXS	♀	.55±.11	.82±.12	—	—	—	65	660	*63*
Average	—	.53	.56	.51	.44	.41	—	—	—
Mature (light):									
WL	♀	.82±.03	—	—	—	—	436	1,897	*203*
WL	♀	.29±.09	.64±.09	.49	—	—	105	300	*23*
WL	♀	.67±.12	.57±.19	.62	—	—	105	300	*23*
WL	♀	.25±.08	.62±.09	.43	—	—	105	300	*23*
WL	♀	.63±.12	.54±.09	.58	—	—	105	300	*23*
WL	♀	.61	—	—	—	—	36	190	*77*
WL	♀	.52	—	—	—	—	36	380	*78*
WL	♀	.47±.18	.80±.16	.63±.10	—	—	20	179	*88*
WL	♀	.93±.29	.69±.15	.81±.12	—	—	18	156	*88*
WL	♀	.73±.23	.48±.11	.60±.11	—	—	18	180	*88*
WL	♀	.57±.28	.69±.18	.63±.13	—	—	10	108	*88*
WL*	♀	.62	.74	—	—	—	104	365	*91*
WL*	♀	.44	.76	—	—	—	300	1,500	*94*
WL*	♀	.85±.11	—	—	—	—	340	1,200	*96*
WL*	♀	.41±.09	—	—	—	—	340	1,200	*96*
WL	♀	.17	—	.47	—	.80	42	218	*108*
WL	♀	.29	—	—	—	—	—	—	*127*
WL	♀	—	—	—	—	.53	140	1,400	*142*
WL	♀	—	—	.64±.02	—	—	85	404	*143*
WL	♀	.57±.31	.32±.37	—	—	—	100	500	*207*
WL	♀	.25±.08	.58±.06	.41±.08	—	—	245	994	*161*
WL*	♀	.43	.73	—	—	—	60	260	*186*
F	♀	—	—	.53±.04	—	—	79	301	*143*
WLX's	♀	—	—	.36	—	—	—	—	*42*
WLX's	♀	.65	—	.44	—	—	501	4,769	*73*
Inbreds	♀	—	—	—	.75	—	98	751	*162*
WLXA	♀	.20	.56	—	—	—	19	152	*11*
WLXRIR	♀	.78±.32	.30±.34	—	—	—	100	500	*207*
RIRXWL	♀	.03±.33	.68±.43	—	—	—	100	500	*207*
Mix	♀	.81	.39	.69	.45	—	25	278	*72*
Average	—	.52	.59	.56	.60	.67	—	—	—

TABLE 1.—*Reported heritability estimates of body weight, weight gain, feed consumption, feed efficiency, conformation, market quality traits, and pigmentation, by age, breed, and sex of chickens*—Continued

Trait, age, and breed of chicken	Sex	Heritability estimate					Degree of freedom		Ref.
		S	D	S+D	b_{OP}	Real.	S	D	
BODY WEIGHT—Con.									
24 weeks—Continued									
Mature (heavy):									
WR	♀	—	—	.38	—	—	32	192	*168*
WR	♀	—	—	.36	—	.49	64	384	*80*
NH	♀	.73	.27	.50	—	—	108	237	*89*
RIR	♀	.28	.36	—	—	—	—	—	*8*
RIR	♀	.37±.13	.86±.13	.62±.07	—	—	26	245	*88*
RIR*	♀	.60±.08	—	—	—	—	541	2,797	*95*
RIR	♀	.70±.45	.17±.50	—	—	—	100	500	*207*
S	♀	.00	.63	—	—	—	—	—	*8*
S	♀	.70±.21	.47±.12	.59±.10	—	—	22	194	*88*
Ot*	♀	—	—	.72	—	—	240	675	*130*
Mix	♀	.60	—	—	.58	—	59	457	*45*
Mix	♀	.51±.16	.59±.09	.64	.58	—	44	481	*72*
Mix	♀	—	—	.65	.52	—	159	609	*197*
Syn	♀	.58±.19	.69±.11	.61±.06	—	—	109	769	*41*
Syn	♀	.35	.63	.57	.67	—	19	243	*72*
Average	—	.49	.52	.56	.59	.49	—	—	—
WEIGHT GAIN									
0 to 3 weeks: WL	♀	.01	.65	—	—	—	4	40	*44*
3 to 6 weeks: WL	♀	.14	.03	—	—	—	4	40	*44*
6 to 9 weeks: WL	♀	.00	−.05	—	—	—	4	40	*44*
9 to 12 weeks: WL	♀	.15	.18	—	—	—	4	40	*44*
4 to 6 weeks: NH	♀	.90	.80	—	—	—	56	218	*183*
4 to 8 weeks: Mix	♀	.61	—	—	—	—	—	—	*74*
6 to 8 weeks: NH	♀	.64	.66	—	—	—	56	218	*183*
8 to 10 weeks: NH	♀	.63	.64	—	—	—	56	218	*183*
Average	—	.35	.42	—	—	—	—	—	—
4 to 6 weeks: NH	♂	.52	.97	—	—	—	56	218	*183*
4 to 8 weeks: Mix	♂	.66	—	—	—	—	—	—	*74*
6 to 8 weeks: NH	♂	.50	1.51	—	—	—	56	218	*183*
8 to 10 weeks: NH	♂	.09	.98	—	—	—	56	218	*183*
Average	—	.44	1.13	—	—	—	—	—	—
4 to 6 weeks: NH	C	.65	.75	—	—	—	56	218	*183*
6 to 8 weeks: NH	C	.52	.79	—	—	—	56	218	*183*
8 to 10 weeks: NH	C	.42	.51	—	—	—	56	218	*183*
Average	—	.53	.68	—	—	—	—	—	—
FEED CONSUMPTION									
4 to 6 weeks: NH	♂	.75	—	—	—	—	56	218	*183*
6 to 8 weeks: NH	♂	.85	—	—	—	—	56	218	*183*
8 to 10 weeks: NH	♂	.53	—	—	—	—	56	218	*183*
Average	—	.73	—	—	—	—	—	—	—

TABLE 1.—*Reported heritability estimates of body weight, weight gain, feed consumption, feed efficiency, conformation, market quality traits, and pigmentation, by age, breed, and sex of chickens*—Continued

Trait, age, and breed of chicken	Sex	Heritability estimate					Degree of freedom		Ref.
		S	D	S+D	b_{OD}	Real.	S	D	
FEED CONSUMPTION—Continued									
4 to 6 weeks: NH	♀	.76	—	—	—	—	56	218	*183*
6 to 8 weeks: NH	♀	.90	—	—	—	—	56	218	*183*
8 to 10 weeks: NH	♀	.95	—	—	—	—	56	218	*183*
Average	—	.87	—	—	—	—	—	—	—
4 to 6 weeks: NH	C	.73	.63	—	—	—	56	218	*183*
6 to 8 weeks: NH	C	.76	.70	—	—	—	56	218	*183*
8 to 10 weeks: NH	C	.60	.44	—	—	—	56	218	*183*
Average	—	.70	.59	—	—	—	—	—	—
FEED EFFICIENCY									
4 to 6 weeks: NH	♂	.32	—	—	—	—	56	218	*183*
6 to 8 weeks: NH	♂	.06	—	—	—	—	56	218	*183*
8 to 10 weeks: NH	♂	.05	—	—	—	—	56	218	*183*
Average	—	.14	—	—	—	—	—	—	—
4 to 6 weeks: NH	♀	.65	—	—	—	—	56	218	*183*
6 to 8 weeks: NH	♀	−.05	—	—	—	—	56	218	*183*
8 to 10 weeks: NH	♀	.26	—	—	—	—	56	218	*183*
Average	—	.29	—	—	—	—	—	—	—
1 to 7 days: WC	C	.66	—	—	—	—	16	96	*119*
8 to 14 days: WC	C	.19	—	—	—	—	16	96	*119*
15 to 21 days: WC	C	.14	—	—	—	—	16	96	*119*
22 to 28 days: WC	C	.32	—	—	—	—	16	96	*119*
1 to 28 days: WC	C	.25	—	—	—	—	16	96	*119*
4 to 6 weeks: NH	C	.48	.37	—	—	—	56	218	*183*
6 to 8 weeks: NH	C	.03	.46	—	—	—	56	218	*183*
8 to 10 weeks: NH	C	.11	.35	—	—	—	56	218	*183*
Average	—	.27	.39	—	—	—	—	—	—
FEATHERING									
8 weeks: WR	♂	—	—	.38	—	—	32	192	*168*
Back – 10 days: WR	♂	—	—	—	.35	—	—	—	*170*
Breast – 10 days: WR	♂	—	—	—	.34	—	—	—	*170*
Back – 5 weeks: WR	♂	—	—	—	.48	—	—	—	*170*
Back – 7 weeks: WR	♂	—	—	—	.58	—	—	—	*170*
Pins – 10 weeks: WR	♂	—	—	—	.43	—	—	—	*170*
Down – 10 weeks: WR	♂	—	—	—	.25	—	—	—	*170*
Average	—	—	—	.38	.41	—	—	—	—
8 weeks: WR	♀	—	—	.30	—	—	32	192	*168*
Back – 10 days: WR	♀	—	—	—	.46	—	—	—	*170*
Breast – 10 days: WR	♀	—	—	—	.29	—	—	—	*170*
Back – 5 weeks: WR	♀	—	—	—	.50	—	—	—	*170*
Back – 7 weeks: WR	♀	—	—	—	.20	—	—	—	*170*
Pins – 10 weeks: WR	♀	—	—	—	.51	—	—	—	*170*
Down – 10 weeks: WR	♀	—	—	—	.39	—	—	—	*170*
Average	—	—	—	.30	.39	—	—	—	—

TABLE 1.—*Reported heritability estimates of body weight, weight gain, feed consumption, feed efficiency, conformation, market quality traits, and pigmentation, by age, breed, and sex of chickens*—Continued

Trait, age, and breed of chicken	Sex	Heritability estimate: S	D	S+D	b_{OD}	Real.	Degree of freedom: S	D	Ref.
FEATHERING—Continued									
10 days: NH	C	—	—	.36	.06	—	—	—	*34*
8 weeks: WR	C	—	—	.34	—	—	32	192	*168*
8 weeks: BR	C	—	—	.42	—	—	18	85	*79*
8 weeks: NH	C	—	—	.33	—	—	9	48	*79*
8 to 12 weeks: NH	C	—	—	.16	.19	—	—	—	*34*
Breast (broiler): WR	C	.50	.38	.44	—	—	3	30	*58*
Breast (broiler): WR	C	.02	.00	.01	—	—	3	30	*58*
Average	—	.26	.19	.29	.13	—	—	—	—
BREAST WIDTH									
8 to 12 weeks: NH	C	—	—	.21	.12	—	—	—	*34*
12 weeks:									
NH	C	.20	—	—	—	—	8	85	*3*
NH	C	.13	.29	.21	—	—	8	29	*106*
Average	—	.17	.29	.21	.12	—	—	—	—
BREAST ANGLE									
8 weeks:									
WR	♂	.48	.32	.40	—	—	36	161	*171*
WR	♂	.30	.39	.34	.26	.31	64	380	*166*
WR	♂	—	—	—	—	.24	32	192	*164*
—	♂	.30	—	—	—	—	20	164	*15*
9 weeks:									
SO	♂	.59	.37	.48	.34±.11	—	14	110	*48*
NH	♂	.20	.62	.41	.37±.10	—	12	120	*48*
Ot*	♂	—	—	—	.45±.03	—	395	1,128	*129*
44 weeks: Ot*	♂	—	—	.45	—	—	240	675	*130*
Average	—	.39	.43	.42	.36	.28	—	—	—
8 weeks:									
WR	♀	.23	.35	.30	.20	.31	64	380	*166*
WR	♀	—	—	—	—	.21	32	192	*164*
—	♀	.30	—	—	—	—	20	164	*15*
9 weeks:									
SO	♀	.50	.22	.36	.42±.11	—	14	110	*48*
NH	♀	.48	.66	.57	.50±.11	—	12	120	*48*
Ot*	♀	—	—	—	.40±.03	—	395	1,128	*129*
44 weeks: Ot*	♀	—	—	.45	—	—	240	675	*130*
Average	—	.40	.41	.42	.38	.26	—	—	—
8 weeks: WR	C	.26	.37	.32	.23	.31	64	380	*166*
9 weeks: Ot*	C	—	—	.43±.02	—	—	395	1,128	*129*
10 weeks:									
SO	C	.10	.79	.44	—	—	10	100	*21*
Mix	C	.46	—	—	—	—	82	440	*19*
NH	C	.35	.60	.47	—	—	10	100	*21*
NHXSO	C	.68	.37	.52	—	—	10	100	*21*
SOXNH	C	.34	.47	.40	—	—	10	100	*21*
12 weeks:									
NH	C	.38	—	—	—	—	8	85	*3*
NH	C	.50	.48	.49	—	—	8	29	*106*
Average	—	.38	.51	.44	.23	.31	—	—	—

TABLE 1.—*Reported heritability estimates of body weight, weight gain, feed consumption, feed efficiency, conformation, market quality traits, and pigmentation, by age, breed, and sex of chickens*—Continued

Trait, age, and breed of chicken	Sex	Heritability estimate					Degree of freedom		Ref.
		S	D	S+D	b_{OD}	Real.	S	D	
BODY DEPTH									
10 weeks:									
NH	♂	.16	—	.35	—	—	8	66	*35*
NH	♀	.22	—	.55	—	—	8	66	*35*
Average	—	.19	—	.45	—	—	—	—	—
KEEL LENGTH									
8 weeks: ——	♂	.59	—	—	—	—	20	164	*15*
9 weeks: Ot	♂	—	—	—	.56±.03	—	395	1,128	*129*
10 weeks: NH	♂	.27	—	.52	—	—	8	66	*35*
44 weeks: Ot*	♂	—	—	.55	—	—	240	675	*130*
8 weeks: ——	♀	.56	—	—	—	—	20	164	*17*
9 weeks: Ot	♀	—	—	—	.56±.03	—	395	1,128	*129*
10 weeks: NH	♀	.35	—	.47	—	—	8	66	*35*
44 weeks: Ot*	♀	—	—	.52	—	—	240	675	*130*
8 to 12 weeks: NH	C	—	—	.49	.48	—	—	—	*34*
9 weeks: Ot*	C	—	—	—	.56±.02	—	395	1,128	*129*
12 weeks:									
NH	C	.55	—	—	—	—	8	85	*3*
NH	C	.50	.17	.34	—	—	8	29	*106*
Average	—	.47	.17	.48	.54	—	—	—	—
SHANK LENGTH									
9 weeks: Ot*	♂	—	—	—	.50±.03	—	395	1,128	*129*
10 weeks: NH	♂	.04	—	.29	—	—	8	66	*35*
44 weeks: Ot*	♂	—	—	.62	—	—	240	675	*130*
9 weeks: Ot*	♀	—	—	—	.45±.03	—	395	1,128	*129*
10 weeks: NH	♀	.23	—	.56	—	—	8	66	*35*
Mature:									
WL	♀	—	—	.29	.33±.16	—	—	108	*109*
WL	♀	—	—	.41	.54±.20	—	—	139	*109*
44 weeks: Ot*	♀	—	—	.58	—	—	240	675	*130*
Average	—	.13	—	.46	.45	—	—	—	—
SHANK DIAMETER									
8 weeks:									
——	♂	.63	—	—	—	—	20	164	*15*
——	♀	.60	—	—	—	—	20	164	*15*
Average	—	.61	—	—	—	—	—	—	—
WEIGHT/SHANK LENGTH									
8 weeks:									
——	♂	.44	—	—	—	—	20	164	*15*
——	♀	.54	—	—	—	—	20	164	*15*
Average	—	.49	—	—	—	—	—	—	—
BREAST BLISTERS									
WR	C	.16	.24	.20	—	—	3	30	*58*
WR	C	.00	.00	.00	—	—	3	30	*58*
Average	—	.08	.12	.10	—	—	—	—	—

TABLE 1.—*Reported heritability estimates of body weight, weight gain, feed consumption, feed efficiency, conformation, market quality traits, and pigmentation, by age, breed, and sex of chickens*—Continued

Trait, age, and breed of chicken	Sex	Heritability estimate					Degree of freedom		Ref.
		S	D	S+D	b_{op}	Real	S	D	
DRESSING PERCENT (BROILER)									
WR	♂	.69	.32	.50	—	—	36	161	*171*
AC*	C	.12	.16	.14	—	—	161	239	*139*
Average	—	.41	.24	.32	—	—	—	—	—
SHANK PIGMENT									
8 weeks:									
Meat	♂	.49	.30	.39	—	—	32	270	*137*
Meat	♂	.21	.69	.45	—	—	44	428	*202*
Meat	♀	.57	.28	.43	—	—	32	270	*137*
Meat	♀	.16	.23	.19	—	—	44	428	*202*
Average	—	.36	.38	.37	—	—	—	—	—

Table 2 summarizes the heritability estimates of egg production and other traits associated with egg production.

There appears to be little, if any, difference in the average heritabilities of short, intermediate, and long-term survivor production (0.22, 0.19 and 0.22, respectively) based on the paternal half-sib correlation. However, the maternal half-sib average estimates are more than 30 percent higher (0.32, 0.35 and 0.30, respectively), suggesting a possible importance of either maternal or dominance effects, or both, for survivor production. There are fewer heritability estimates of short- and long-term hen-housed production and apparently these differ according to paternal half-sib correlation estimates (0.33 and 0.15). However, the average estimates from the maternal half-sib correlation are similar for both short- and long-term hen-housed production (0.40 and 0.41). As in survivor production, there is an apparent importance of either maternal or dominance effects, or both. Short-term rate of production appears to have a lower heritability (0.11) than short-term survivor production or hen-housed production; and again either maternal or dominance effects, or both, appear to be considerable as evidenced by the average maternal half-sib correlations (0.45). Long-term rate of production has an average heritability of 0.15 by the paternal half-sib correlation, but there is only one estimate by the maternal half-sib correlation (0.64). Winter rate of production appears to have a higher heritability, but all estimates were reported by a single investigator. There is no apparent importance of either maternal or dominance effects indicated by the meager data for this trait.

Egg mass appears to have a heritability of a magnitude similar to that of egg production. There is no convincing evidence of either maternal or dominance effects.

A great many estimates of the heritability of sexual maturity have been reported. The average of estimates tabulated for the paternal half-sib correlation indicates a heritability of approximately 0.39 for this trait in both light and heavy breeds.

There is limited information regarding broodiness, pauses, and persistency, but reports indicate a low heritability for these traits.

The heritability estimates of egg traits are reported in table 3.

There are a large number of reports of the heritability of early and mature egg weight. The average estimates by the paternal half-sib correlation indicate a high heritability of early egg weight for light and heavy breeds (0.45 and 0.57). Similar average estimates of heritability of mature egg weight for light and heavy breeds (0.46 and 0.58) suggest no difference in the heritability of pullet and mature egg weight.

Either maternal or dominance effects, or both, are suggested by the fact that the maternal half-sib estimates are about 15 percent higher than the paternal half-sib estimates for early egg weight, but there is no indication of these effects for mature egg weight.

Average estimates of the heritability of specific gravity for light and heavy breeds are 0.35 and 0.40 as estimated by the paternal half-sib correlation and there is no evidence of important maternal or dominance effects.

Egg shape appears to be quite highly heritable in both light and heavy breeds (0.35 and 0.32) as estimated by the paternal half-sib correlation.

Shell color is apparently quite highly heritable. There is evidence of important dominance or maternal influences, or both, as indicated by the difference in average paternal and maternal half-sib correlations (0.35 and 0.56).

Haugh units and albumen height have similar average paternal half-sib correlation estimates (0.42 and 0.43), but the average for albumen score is lower (0.27).

Reported estimates are too few to permit meaningful comments concerning the following traits: yolk weight, yolk weight/egg weight, yolk size, albumen weight, albumen weight/yolk weight, albumen percent, blood spots, meat spots, shell thickness, shell strength, shell texture, shell defects, yolk color, mottling, Haugh units stored, and quality loss.

Table 4 is a summary of fertility, hatchability, mortality, aggressiveness, and physiological traits.

Based on estimates from only three reports, fertility appears to have a low heritability. Hatchability measured as a percentage of all eggs set has a lower average heritability (0.09) than hatchability measured on the probit scale (0.19). However, hatchability of fertile eggs, measured in percent, has a higher average heritability (0.14) than hatchability of fertile eggs measured on the probit scale (0.07).

Mortality up to 10 weeks of age, annual laying house mortality, and mortality due to leucosis are all apparently very lowly heritable (0.02, 0.08, and 0.09, respectively). There is also strong evidence of important maternal or dominance effects, or both, for early and laying house mortality.

Aggressiveness as measured by the realized heritability average is quite highly heritable (0.31).

There are so few estimates of heritability for all traits reported in table 4 that any discussion of the magnitude of the estimates does not seem justified.

TABLE 2.—*Reported heritability estimates of egg production and production traits, by age and breed of chickens*

Trait, age, and breed of chicken	Heritability estimate					Degree of freedom		Ref.
	S	D	S+D	b_{OD}	Real.	S	D	
SURVIVOR PRODUCTION								
Short term								
First 3 months: NH	0.31	0.19	0.25	—	—	108	237	*89*
First 4 months:								
NH	.37	.21	.29	—	—	108	237	*89*
Syn	—	—	—	0.37	—	145	735	*117*
17 weeks > S.M.: S	.02±.05	.15±.11	.09±.05	—	—	12	144	*187*
To Dec. 31: RIRXG	.42	—	—	—	—	—	—	*128*
To January:								
WL	.18	—	—	—	—	40	200	*4*
WL	.31	—	—	—	—	40	200	*4*
WL	.07	—	—	—	—	40	200	*4*
WL	.16	.35	—	—	—	15	136	*17*
WL	.23	.61	—	—	—	46	464	*17*
WL	.18	.43	—	—	—	23	196	*17*
WL	.21	.53	—	—	—	84	796	*92*
WL	—	—	.22	—	—	14	53	*107*
WL	—	—	.48	—	—	20	74	*107*
WL	—	—	.32	—	—	—	—	*111*
WL	.16	.12	.14	—	—	48	604	*146*
WL	.14	.24	.19	—	—	100	904	*198*
S	.21±.12	.29±.10	.25±.07	—	—	12	144	*187*
NH	—	—	.25	—	—	—	—	*69*
May 31 (Australia):								
WL	.29	.36	.33±.05	—	—	42	382	*133*
WL	.23±.10	—	—	—	—	84	700	*135*
Average for short term	.22	.32	.26	.37	—	—	—	—

TABLE 2.—*Reported heritability estimates of egg production and production traits, by age and breed of chickens*—Continued

Trait, age, and breed of chicken	Heritability estimate					Degree of freedom		Ref.
	S	D	S+D	b_{op}	Real.	S	D	
SURVIVOR PRODUCTION—Continued								
Intermediate term								
To 240 days of age: NH	—	—	—	.15	—	48	245	117
9 months of age: WL	.11	.16	—	—	—	—	—	148
40 weeks of age: S	.16±.10	.23±.11	.19±.07	—	—	12	144	187
42 weeks of age: WG*	.28	—	—	—	—	—	—	86
44 weeks of age:								
WL	.27±.07	.26±.07	.27	—	—	105	300	23
WL	.13±.07	.45±.09	.29	—	—	105	300	23
46 weeks of age:								
NH	—	—	.20	.26	—	—	—	34
WG*	.28	.05	.17	—	—	—	—	55
WL	—	—	.26	—	—	—	—	69
11 months of age: WL	.16	—	—	—	—	36	190	78
350 days of age: WL	—	—	.13	—	—	—	—	117
365 days of age:								
RIR	.18	—	—	—	—	31	121	65
WL	.23±.07	.40±.08	.31±.10	—	—	245	994	161
55 weeks of age: S	.21±.13	.38±.13	.29±.08	—	—	12	144	187
To March:								
WL	.14	.34	—	—	—	15	136	17
WL	.14	.61	—	—	—	46	464	17
WL	.20	.46	—	—	—	23	196	17
WL	.16	.52	—	—	—	84	796	92
Average for intermediate term	.19	.35	.23	.21	—	—	—	—
Long term								
32 weeks>maturity: S	.14±.10	.35±.12	.25±.07	—	—	12	144	187
250 days>maturity:								
BLXBL	.18±.08	.22±.14	—	—	—	65	660	63
BLXS	.18±.06	.38±.12	—	—	—	65	660	63
SXBL	.23±.08	.30±.12	—	—	—	65	660	63
SXS	.36±.09	.32±.11	—	—	—	65	660	63
65 weeks of age: S	.31±.07	.48±.13	.40±.09	—	—	12	144	187
319 days>housing: Mix	—	—	.28	.17	—	—	—	101
300 days>maturity: WL	.14	.14	.14	—	—	48	604	146
500 days of age:								
WLXA	.44	.59	—	—	—	19	152	11
Inbreds	—	—	—	.29	—	98	751	162
October to July: Mix	.24	—	—	—	—	36	269	71
72 weeks of age:								
WL	—	—	.23	—	—	36	97	1
WL	.32	—	—	—	—	52	299	29
WL	.21	.45	.33±.06	—	—	42	382	133
WW	.42±.12	.14±.09	.28±.07	—	—	46	232	59
To May 1: S	.23±.13	.31±.10	.27±.07	—	—	12	144	187
To May 31:								
WL	—	—	.46	—	—	20	74	107
WL	—	—	.15	—	—	14	53	107
To June 1:								
WL	.02	.33	—	—	—	15	136	17
WL	.15	.40	—	—	—	23	196	17
WL	.10	.48	—	—	—	46	464	17
WL	.12	.44	—	—	—	84	796	17
To June 30: WL	—	—	.24	—	—	—	—	111
To August: S	.27±.14	.41±.11	.34±.08	—	—	12	144	187
To September 30: WL	—	—	.26	—	—	—	—	111

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TABLE 2.—*Reported heritability estimates of egg production and production traits, by age and breed of chickens*—Continued

Trait, age, and breed of chicken	Heritability estimate					Degree of freedom		Ref.
	S	D	S+D	b_{OP}	Real.	S	D	
SURVIVOR PRODUCTION—Continued								
Long term—Continued								
Annual:								
WL	−.05	.22	—	—	—	15	136	*17*
WL	.09	.38	—	—	—	46	464	*17*
WL	.11	.29	—	—	—	23	196	*17*
WL	—	—	.34	—	—	—	—	*39*
WL	—	—	.15	—	—	36	190	*77*
WL	.16±.09	.05±.13	.11±.07	—	—	20	179	*88*
WL	.23±.12	.30±.14	.26±.08	—	—	18	156	*88*
WL	.23	.10	.17	.57	—	—	—	*28*
WL	.30±.13	.35±.11	.33±.07	—	—	18	180	*88*
WL	.16	.14	—	—	—	130	1,000	*110*
WL	.45	.16	—	—	—	130	1,000	*110*
WL	—	.05	—	—	—	130	1,000	*110*
WL	—	—	.15	—	—	4	53	*107*
WL	—	—	.50	—	—	20	74	*107*
WL	.38	—	—	—	—	—	—	*127*
WL	.16	.15	.15	—	—	48	604	*146*
WL	—	—	.27±.11	—	—	30	260	*150*
WL	.18±.05	.74±.11	.46	.22±.08	—	64	520	*160*
NH	.13	.11	.12	—	—	108	237	*89*
F	.16	.12	.14	—	—	15	48	*6*
S	.16	.68	—	—	—	—	—	*8*
A	.25	—	—	—	—	28	69	*114*
400 to 450 days>maturity:								
S	—	—	.45	—	—	26	104	*61*
BL	—	—	.34	—	—	24	83	*61*
BLXBL	.42±.12	.14±.09	.28±.07	—	—	46	232	*62*
BLXS	.24±.08	.00±.13	—	—	—	65	660	*63*
SXBL	.11±.06	.36±.12	—	—	—	65	660	*63*
SXS	.34±.09	.30±.12	—	—	—	65	660	*63*
500 days>maturity: WL	.16	.15	.15	—	—	48	604	*146*
Average for long term	.22	.30	.27	.31	—	—	—	—
Month 1: NH	.15	.21	.18	—	—	108	237	*89*
Months 1 and 2: NH	.32	.15	.24	—	—	108	237	*89*
November and December:								
WL	—	—	.34	—	—	10	79	*90*
BR	—	—	.18	—	—	10	79	*90*
January and February:								
WL	—	—	.59	—	—	10	79	*90*
BR	—	—	.34	—	—	10	79	*90*
January through March:								
WL	−.03	.41	—	—	—	15	136	*17*
WL	.03	.38	—	—	—	46	464	*17*
WL	.14	.33	—	—	—	23	196	*17*
Winter:								
WL	—	—	.27	—	—	36	97	*1*
WL	—	—	.26	—	—	40	137	*2*
March and April:								
WL	—	—	.36	—	—	10	77	*90*
BR	—	—	.27	—	—	10	78	*90*
March through June:								
WL	−.12	.37	—	—	—	15	136	*17*
WL	.10	.30	—	—	—	46	464	*17*
WL	.10	.25	—	—	—	23	196	*17*
May and June:								
WL	—	—	.49	—	—	10	74	*90*
WL	—	—	.42	—	—	10	73	*90*
BR	—	—	.09	—	—	10	76	*90*

TABLE 2.—*Reported heritability estimates of egg production and production traits, by age and breed of chickens*—Continued

Trait, age, and breed of chicken	Heritability estimate					Degree of freedom		Ref.
	S	D	S+D	b_{OD}	Real.	S	D	
SURVIVOR PRODUCTION—Continued								
July and August:								
WL	—	—	.42	—	—	10	73	*90*
BR	—	—	.17	—	—	10	69	*90*
January 1 to 72 weeks of age: WL	.16±.11	—	—	—	—	84	700	*135*
June to 365 days >S.M.:								
WL	−.19	.06	—	—	—	15	136	*17*
WL	.24	.35	—	—	—	46	464	*17*
WL	.24	.18	—	—	—	23	196	*17*
250 to 450 days >S.M.:								
BLXBL	.24±.08	.22±.14	—	—	—	65	660	*63*
BLXS	.11±.06	.39±.12	—	—	—	65	660	*63*
SXBL	.34±.09	.21±.12	—	—	—	65	660	*63*
SXS	.29±.08	.09±.10	—	—	—	65	660	*63*
Annual minus winter: WL	—	—	.14	—	—	40	137	*2*
September to February: WL	—	—	.55	—	—	5	73	*16*
To 28 weeks of age:								
WL	.26±.07	.39±.07	.32	—	—	105	300	*23*
WL	.23±.08	.44±.09	.33	—	—	105	300	*23*
28 to 36 weeks of age:								
WL	.14±.05	.18±.06	.16	—	—	105	300	*23*
WL	.15±.06	.23±.08	.19	—	—	105	300	*23*
36 to 44 weeks:								
WL	.20±.06	.16±.06	.18	—	—	105	300	*23*
WL	.11±.06	.41±.09	.26	—	—	105	300	*23*
HEN HOUSED PRODUCTION								
Short term								
To December 31: WL	—	—	.28	—	—	—	—	*111*
To May 31 (Australia): WL	.27	.37	.32±.05	.10	—	42	383	*133*
To January: WL	.32	.35	—	—	—	84	796	*92*
To March: WL	.39	.49	—	—	—	84	796	*92*
To 46 weeks: NH	—	—	.12	.20	—	—	—	*34*
Average for short term	.33	.40	.24	.15	—	—	—	—
Long term								
To May 31: WL	.23±.11	—	—	—	—	84	700	*135*
To June 30: WL	—	—	.22	—	—	—	—	*111*
To June: WL	.19	.37	—	—	—	84	796	*92*
October to July: Mix	—	.20	—	—	—	36	269	*71*
To September 30: WL	—	—	.22	—	—	—	—	*111*
To 500 days of age:								
WL*	.07	.59	—	—	—	300	1,500	*74*
Ot*	—	—	.20	—	—	240	675	*130*
To 72 weeks of age:								
WL	.00	.60	—	—	—	60	260	*186*
WL	.19	.43	.31±.05	.26	—	42	383	*133*
Annual:								
WL	.16	.33	—	—	—	84	796	*92*
WL	.24±.06	.36±.08	—	.30±.08	—	64	582	*160*
WLX's	—	—	.13	—	—	—	—	*42*
Average for long term	.15	.41	.22	.28	—	—	—	—

TABLE 2.—*Reported heritability estimates of egg production and production traits, by age and breed of chickens*—Continued

Trait, age, and breed of chicken	Heritability estimate					Degree of freedom		Ref.
	S	D	S+D	b_{OD}	Real.	S	D	
RATE OF PRODUCTION								
Short term								
To December 15:								
Syn	.15±.04	.69±.13	.39±.05	—	—	109	769	*41*
WL	.13±.09	—	—	.23±.05	—	105	305	*97*
To January 1:								
Syn	.18±.12	—	—	.23±.04	—	100	250	*97*
WL	.14	.16	.15	—	—	48	604	*146*
WL*	.06	.43	—	—	—	104	365	*91*
WR	—	—	.22	—	—	64	380	*167*
WL	—	—	.21	—	—	32	192	*168*
WL	—	—	.14	—	—	64	384	*80*
To 34 weeks of age: WL	.07±.05	—	—	—	—	160	750	*203*
To 9 months of age:								
WL	—	—	.08±.02	—	—	85	404	*143*
F	—	—	.10±.04	—	—	79	301	*143*
To 260 days of age:								
WL	−.03±.32	.73±.44	—	—	—	100	500	*207*
RIR	−.10±.48	.92±.60	—	—	—	100	500	*207*
RIRXWL	.09±.30	.28±.39	—	—	—	100	500	*207*
WLXRIR	.19±.27	−.08±.35	—	—	—	100	500	*207*
To 40 weeks of age:								
WL*	.15±.07	—	—	—	—	340	1,200	*96*
WL*	.21±.07	—	—	—	—	340	1,200	*96*
RIR*	.18±.06	—	—	—	—	562	3,089	*95*
Average for short term	.11	.45	.18	.23	—	—	—	—
Long term								
To 55 weeks of age:								
WL*	.15±.07	—	—	—	—	340	1,200	*96*
WL	.06±.07	—	—	—	—	340	1,200	*96*
To 64 weeks of age: WL	.04±.06	—	—	—	—	160	750	*203*
22 to 64 weeks of age: WL	.18± 05	—	—	—	—	160	750	*203*
To 65 weeks of age: F	—	—	.25±.02	—	—	79	301	*143*
To 70 weeks of age:								
WL*	.16±.07	—	—	—	—	340	1,200	*96*
WL*	.11±.07	—	—	—	—	340	1,200	*96*
To 72 weeks of age: WL	.16	.64	—	—	—	104	365	*92*
To May 31: Mix	—	—	.51	.00	—	159	609	*197*
Annual:								
WL	—	—	—	—	0.04	140	1,400	*142*
WL	.23	—	.18	.12	—	99	298	*190*
Average for long term	.15	.64	.31	.12	.04	—	—	—
Winter:								
Light	.02	.38	.29	—	—	25	278	*72*
Light	.36	.45	.41	.35±.10	—	25	278	*72*
Heavy	.25	.17	.27	.15	—	19	243	*72*
Heavy	1.15	.55	.85	.35±.10	—	19	243	*72*
Mix	.17±.09	.29±.09	.30	.07	—	44	481	*72*
Mix	.85±.20	.52±.09	.68±.09	.35±.07	—	44	481	*72*
Average	.47	.40	.47	.25	—	—	—	—
22 to 34 weeks of age: WL	.39±.05	—	—	—	—	160	750	*203*
34 to 64 weeks of age: WL	.02±.04	—	—	—	—	160	750	*203*
40 to 55 weeks of age:								
WL*	.15±.07	—	—	—	—	340	1,200	*96*
WL*	.06±.07	—	—	—	—	340	1,200	*96*

TABLE 2.—*Reported heritability estimates of egg production and production traits, by age and breed of chickens*—Continued

Trait, age, and breed of chicken	Heritability estimate					Degree of freedom		Ref.
	S	D	S+D	b_{op}	Real.	S	D	
RATE OF PRODUCTION—Continued								
55 to 70 weeks of age:								
WL*	.06±.06	—	—	—	—	340	1,200	*96*
WL*	.10±.07	—	—	—	—	340	1,200	*96*
December 1 to March 31: Mix	—	—	.41	.11	—	159	609	*197*
January to June: Inbreds	—	—	—	.31	—	87	—	*194*
March to May 31: Mix	—	—	.38	.00	—	159	609	*197*
EGG MASS								
To January: S	.16±.10	.25±.11	.20±.07	—	—	12	144	*187*
To 17 weeks >S.M.: S	.11±.08	.04±.09	.08±.06	—	—	12	144	*187*
To 32 weeks >S.M.: S	.27±.14	.24±.11	.25±.08	—	—	12	144	*187*
To May: S	.28±.15	.30±.11	.29±.08	—	—	12	144	*187*
To 40 weeks of age: S	.14±.10	.24±.11	.19±.07	—	—	12	144	*187*
To 55 weeks of age: S	.24±.14	.41±.13	.33±.08	—	—	12	144	*187*
To 65 weeks of age: S	.41±.20	.49±.13	.45±.10	—	—	12	144	*187*
To August: S	.42±.20	.41±.21	.41±.10	—	—	12	144	*187*
SEXUAL MATURITY								
Light breeds:								
WL	—	—	.15	—	—	36	97	*1*
WL	—	—	.12	—	—	40	137	*2*
WL's	.48±.05	—	—	—	—	160	750	*203*
WL	.42	.55	—	—	—	15	136	*17*
WL	.49	.48	—	—	—	46	464	*17*
WL	.24	.80	—	—	—	23	196	*17*
WL	.27±.07	.28±.07	.27	—	—	105	300	*23*
WL	.17±.08	.47±.09	.32	—	—	105	300	*23*
WL	.26	—	—	—	—	52	299	*29*
WL	—	—	.40	—	—	—	—	*39*
WL*	.27	.27	—	—	—	168	559	*68*
WL*	.09	.45	—	—	—	300	1,500	*74*
WL	.38	.55	—	—	—	84	796	*92*
WL*	.26	.57	—	—	—	104	365	*91*
WL*	.27±.08	—	—	—	—	340	1,200	*96*
WL*	.38±.08	—	—	—	—	340	1,200	*96*
WL	.21±.10	—	—	—	—	25	729	*100*
WL	.22±.09	—	—	—	—	25	1,058	*100*
WL	.24	—	.31	.35	—	42	218	*108*
WL	—	—	.34	—	—	—	—	*111*
WL	.29	—	—	—	—	—	—	*127*
WL	.16	—	—	—	—	20	68	*147*
WL	.48±.31	.38±.42	—	—	—	100	500	*207*
WL	.31±.06	.32±.06	.31±.05	—	—	245	994	*161*
WL*	.07	.34	—	—	—	60	260	*186*
WLXX's	.22	—	.31	—	—	464	3,036	*31*
WLX's	.51	—	.45	—	—	501	4,769	*73*
BL	—	—	.43	—	—	24	84	*61*
BLXBL	.19±.07	.66±.14	—	—	—	65	66	*63*
WLXA	.90	.65	—	—	—	19	152	*11*
RIRXWL	.65±.30	.18±.31	—	—	—	100	500	*207*
WLXRIR	.22±.30	.25±.37	—	—	—	100	500	*207*
BLXS	.35±.09	.35±.12	—	—	—	65	660	*63*
SXBL	.25±.08	.26±.12	—	—	—	65	660	*63*
Inbreds	—	—	—	.26	—	98	751	*162*
Average for light breeds	.39	.44	.42	.31	—	—	—	—

TABLE 2.—*Reported heritability estimates of egg production and production traits, by age and breed of chickens*—Continued

Trait, age, and breed of chicken	Heritability estimate					Degree of freedom		Ref.
	S	D	S+D	b_{op}	Real.	S	D	
SEXUAL MATURITY—Con.								
Heavy breeds:								
WR	—	—	.41	—	—	71	318	*205*
WR	—	—	.28	—	—	64	384	*80*
WR	—	—	.49	—	—	64	380	*167*
WR	—	—	.38	—	—	32	192	*168*
RIR	.14	.25	—	—	—	—	—	*8*
RIR*	.33±.06	—	—	—	—	562	3,089	*95*
RIR	.21	—	.39	.40±.14	—	18	140	*149*
RIR	.45±.37	.13±.38	—	—	—	100	500	*207*
NH	—	—	.25	.33	—	—	—	*34*
NH	.35	.23	.30	—	—	108	237	*89*
WW	.21±.08	.14±.10	.18±.05	—	—	46	232	*62*
S	.30	.46	—	—	—	—	—	*8*
S	—	—	.41	—	—	27	107	*61*
Ot*	—	—	.34	—	—	240	675	*130*
Syn	.16±.09	—	—	—	—	110	320	*97*
Syn	.06±.11	—	—	—	—	105	265	*97*
Mix	—	—	.07	.20	—	—	—	*101*
SXS	.40±.19	.31±.10	—	—	—	65	660	*63*
RIRXG	.31	—	—	—	—	—	—	*128*
Average for heavy breeds	.39	.25	.32	.31	—	—	—	—
BROODINESS								
Nag.XWL	.16	.56	.11	—	—	30	70	*156*
PAUSES								
Long: Mix	—	—	.23	.20	—	—	—	*101*
Short: Mix	—	—	.21	.16	—	—	—	*101*
Winter:								
RIR	.08	.09	—	—	—	100	438	*64*
RIR	.12	.20	—	—	—	100	438	*64*
Average	.10	.15	.22	.18	—	—	—	—
PERSISTENCY								
S	.20	.49	—	—	—	—	—	*8*
Mix	—	—	.10	—	—	—	—	*101*
OVIPOSITION INTERVAL								
WL	.59	.74	.66	—	—	20	69	*182*

TABLE 3.—*Reported heritability estimates of egg traits, by breed of chickens*

Trait of egg and breed of chicken	Heritability estimate					Degree of freedom		Ref.
	S	D	S+D	b_{OD}	Real.	S	D	
EARLY EGG WEIGHT								
Light breeds:								
WL	0.49	—	—	—	—	40	200	*4*
WL	.33±.03	—	—	—	—	80	350	*203*
WL	.25±.08	0.62±.09	0.34	—	—	105	300	*23*
WL	.38±.08	.30±.07	.49	—	—	105	300	*23*
WL	.45±.10	.40±.09	.42	—	—	105	300	*23*
WL	.47±.10	.54±.09	.50	—	—	105	300	*23*
WL	—	—	.45±.07	—	—	230	2,270	*40*
WL	—	—	—	—	0.40±.05	115	1,135	*40*
WL	—	—	—	0.33	—	40	—	*70*
WL	.72±.19	.29±.22	.50±.13	—	—	40	287	*87*
WL	.15	.27	—	—	—	84	796	*92*
WL*	.60	.73	—	—	—	104	365	*91*
WL*	.51	.64	—	—	—	300	1,500	*94*
WL*	.53±.09	—	—	—	—	340	1,200	*96*
WL*	.51±.10	—	—	—	—	340	1,200	*96*
WL	.48	—	.36	.61	—	42	218	*108*
WL	.60	—	.50	.61	—	42	218	*108*
WL	.26±.36	.86±.44	—	—	—	100	500	*207*
WL	.20±.07	.63±.09	.41±.11	—	—	245	994	*161*
WL	.72	.42	—	—	—	60	260	*186*
WLX's	.64	—	.49	—	—	501	4,769	*73*
WLXA	.45	—	—	—	—	45	208	*136*
WLXRIR	.41±.36	.53±.42	—	—	—	100	500	*207*
RIRXWL	.20±.34	.72±.44	—	—	—	100	500	*207*
Average for light breeds	.45	.53	.45	.52	.40	—	—	—
Heavy breeds:								
WR	—	—	—	.62	—	64	380	*167*
WR	—	—	.63	—	—	32	192	*168*
RIR	.72±.09	—	—	—	—	544	2,692	*95*
RIR	.01±.67	.31±.77	—	—	—	100	500	*207*
NH	.62	.56	.59	—	—	108	237	*89*
S	.75±.31	.72±.17	.73±.14	—	—	12	144	*187*
S	.70±.30	.80±.16	.75±.13	—	—	12	144	*187*
S	.87±.31	.76±.13	.82±.14	—	—	12	144	*187*
WG*	.60	—	—	—	—	—	—	*86*
Syn	.28±.28	.76±.21	.48±.10	—	—	109	769	*41*
Average for heavy breeds	.57	.65	.67	.63	—	—	—	—
MATURE EGG WEIGHT								
Light breeds:								
WL	—	—	.51	—	—	36	97	*1*
WL	—	—	.49	—	—	40	137	*2*
WL	.47	—	—	—	—	40	200	*4*
WL	.53	—	—	—	—	40	200	*4*
WL	.61±.05	—	—	—	—	80	350	*203*
WL	—	—	.58	—	—	5	73	*16*
WL	.44±.10	.68±.09	.56	—	—	105	300	*23*
WL	.45±.10	.61±.09	.53	—	—	105	300	*23*
WL	.53±.11	.60±.09	.56	—	—	105	300	*23*
WL	.61±.09	.52±.09	.52	—	—	105	300	*23*
WL	.32	.56	—	—	—	16	77	*24*
WL	.59	—	—	—	—	52	299	*29*
WL	.37	—	—	—	—	52	299	*29*
WL	—	—	.51	—	—	—	—	*39*
WL	.68	.58	.63	—	—	—	—	*69*
WL	—	—	—	.16	—	40	—	*70*
WL	—	—	—	.14	—	40	—	*70*

TABLE 3.—*Reported heritability estimates of egg traits, by breed of chickens*—Continued

Trait of egg and breed of chicken	Heritability estimate					Degree of freedom		Ref.
	S	D	S+D	b_{OD}	Real.	S	D	
MATURE EGG WEIGHT—Continued								
Light breeds—Continued								
WL	—	—	—	.16	—	40	—	70
WL	.51	—	—	—	—	36	190	77
WL	.36	—	—	—	—	36	380	78
WL	.80±.24	.43±.13	.61±.12	—	—	20	179	88
WL	.35±.16	.62±.16	.48±.09	—	—	18	156	88
WL	.55±.20	.58±.12	.57±.09	—	—	18	180	88
WL	.45±.24	.56±.18	.50±.10	—	—	10	108	88
WL	.14	.20	—	—	—	84	796	92
WL*	.53	.58	—	—	—	300	1,500	94
WL*	.52±.10	—	—	—	—	340	1,200	96
WL*	.41±.09	—	—	—	—	340	1,200	96
WL	.73	—	.47	.39	—	42	218	08
WL	—	—	.42	—	—	—	—	111
WL	.29	—	—	—	—	—	—	127
WL	—	—	—	—	.61	140	1,400	142
WL	—	—	.59±.02	—	—	85	404	143
WL*	—	—	.67±.13	—	—	30	260	150
WL*	—	—	.55±.12	—	—	30	260	150
WL	.09±.33	.86±.45	—	—	—	100	500	207
WL	—	—	.00	—	—	5	58	157
WL*	.67	.41	—	—	—	60	260	186
WL	.18	.41	—	—	—	10	75	200
WL's	.19	.18	—	—	—	—	—	148
WL's	—	—	.10	—	—	—	—	153
WLX's	.50	—	.47	—	—	464	3,036	31
F	.31	.26	.29	—	—	15	48	6
F	—	—	.55±.06	—	—	79	301	143
BL	—	—	.66	—	—	24	83	61
BLXBL	.46±.11	.49±.14	—	—	—	65	660	63
BLXLS	.42±.10	.55±.12	—	—	—	65	660	63
LSXBL	.96±.16	.29±.12	—	—	—	65	660	63
RIRXWL	.30±.35	.47±.41	—	—	—	100	500	207
WLXRIR	.54±.38	.06±.43	—	—	—	100	500	207
Inbreds	—	—	—	.61	—	98	751	162
Mix	—	—	.50	—	—	34	150	38
Mix	.36	.45	.50	.44	—	25	278	72
Average for light breeds	.46	.49	.49	.32	.61	—	—	—
Heavy breeds:								
WR	—	—	.66	—	—	71	318	205
WR	—	—	.67	—	1.07	64	384	80
BR	—	—	.33	—	—	4	50	157
RIR	.38	.82	—	—	—	—	—	8
RIR	.41±.14	.60±.12	.51±.08	—	—	26	245	88
RIR	.78±.10	—	—	—	—	545	2,261	95
RIR	.30±.55	.55±.61	—	—	—	100	500	207
NH	—	—	.54	—	—	13	60	157
NH	.53	.25	.39	—	—	—	—	69
S	.20	.49	—	—	—	—	—	8
S	—	—	.54	—	—	26	104	61
S	.73±.22	.73±.13	.73±.10	—	—	22	194	88
S	.81±.33	.83±.19	.82±.14	—	—	12	144	187
S	.50±.24	.65±.17	.58±.12	—	—	12	144	187
S	.77±.31	.74±.16	.76±.13	—	—	12	144	187
S	.49±.24	.70±.15	.60±.11	—	—	12	144	187
S	.76±.31	.83±.17	.79±.13	—	—	12	144	187
A	.61	—	—	—	—	28	69	114
Ot*	—	—	.67	—	—	240	675	130
WG*	.60	.43	.52	—	—	—	—	55
WG*	.72	.29	.50	—	—	—	—	55
Mix	.72	—	—	.46	—	59	457	45
Mix	1.15	.55	.89	.42	—	19	243	72

TABLE 3.—*Reported heritability estimates of egg traits, by breed of chickens*—Continued

Trait of egg and breed of chicken	Heritability estimate					Degree of freedom		Ref.
	S	D	S+D	b_{OD}	Real.	S	D	
MATURE EGG WEIGHT—Continued								
Heavy breeds—Continued								
Mix	.85±.20	.52±.09	.75	.43	—	44	481	*72*
Mix	—	—	.52	.52	—	159	609	*197*
Syn	.42±.10	—	—	—	—	105	315	*97*
Syn	.29±.08	—	—	—	—	100	265	*97*
Syn	.36±.11	.16±.11	.26±.09	—	—	50	50	*151*
Syn	.37	.02	.20	—	—	50	50	*151*
Average for heavy breeds	.58	.54	.58	.46	1.07	—	—	—
YOLK WEIGHT								
WL	.43±.15	.44±.23	.43±.13	—	—	40	287	*87*
YOLK WEIGHT/ EGG WEIGHT								
WL	.20±.08	—	—	—	—	40	287	*87*
WL	.48	.04	—	—	—	10	75	*200*
YOLK SIZE								
WL	.39	.33	—	—	—	10	75	*200*
ALBUMEN WEIGHT								
WL	—	—	.02	—	—	5	58	*157*
WL	.38	.23	—	—	—	10	75	*200*
NH	—	—	.68	—	—	13	60	*157*
BR	—	—	.12	—	—	4	50	*157*
Average	.38	.23	.27	—	—	—	—	—
ALBUMEN WEIGHT/YOLK WEIGHT								
WL	.78	.13	.46	—	—	11	45	*102*
WL	.34	.49	.41	—	—	10	58	*102*
WL	—	—	.12	—	—	5	58	*157*
NH	—	—	.00	—	—	13	60	*157*
BR	—	—	.02	—	—	14	50	*157*
Average	.56	.31	.21	—	—	—	—	—
ALBUMEN PERCENT								
WL	.38	.23	—	—	—	10	75	*200*
BLOOD SPOTS								
WL	.23	—	—	—	—	52	299	*29*
WL	—	—	.32	—	—	—	—	*39*
WL*	.13	.28	—	—	—	300	1,500	*94*
WLX's	.02	—	.20	—	—	464	3,036	*31*
Average	.13	.28	.26	—	—	—	—	—

TABLE 3.—*Reported heritability estimates of egg traits, by breed of chickens*—Continued

Trait of egg and breed of chicken	Heritability estimate					Degree of freedom		Ref.
	S	D	S+D	b_{op}	Real.	S	D	
MEAT SPOTS								
RIR	.14	.23	—	—	—	42	316	*118*
RIR	—	—	—	—	.68	119	721	*120*
RIR	—	—	—	—	.26	119	721	*120*
SPECIFIC GRAVITY								
Light breeds:								
WL	.26	—	—	—	—	52	299	*29*
WL	.35±.15	.52±.15	.44±.09	—	—	20	179	*88*
WL	.14±.09	.42±.15	.28±.08	—	—	18	156	*88*
WL	.24±.16	.70±.19	.47±.11	—	—	10	108	*88*
WL*	.34	.33	—	—	—	300	1,500	*94*
WL*	.62±.10	—	—	—	—	340	1,200	*96*
WL*	.30±.09	—	—	—	—	340	1,200	*96*
WL	.45±.42	.06±.50	—	—	—	100	500	*207*
WL*	.30	.06	—	—	—	60	260	*186*
WL's	—	—	.04	—	—	10	75	*90*
WLX's	.38	—	.41	—	—	464	3,036	*31*
WLX's	.54	—	.26	—	—	501	4,769	*73*
WLXA	.30	—	—	—	—	45	208	*136*
RIRXWL	.33±.39	.49±.50	—	—	—	100	500	*207*
WLXRIR	.29±.37	.10±.43	—	—	—	100	500	*207*
Average for light breeds	.35	.34	.32	—	—	—	—	—
Heavy breeds:								
WR	—	—	.39	—	—	64	380	*167*
WR	—	—	.44	—	—	32	192	*168*
WR's	—	—	.44	—	—	71	318	*205*
BR's	—	—	.05	—	—	10	77	*90*
RIR	.55±.11	—	—	—	—	478	1,700	*95*
RIR	.33±.51	−.17±.53	—	—	—	100	500	*207*
Syn	.35±.13	.15±.07	.25±.07	—	—	50	50	*151*
RIR	.38	.10	.25	—	—	50	50	*151*
Average for heavy breeds	.40	.03	.30	—	—	—	—	—
SHELL THICKNESS								
WL	—	—	—	.17	—	40	—	*70*
WL	—	—	.38±.09	—	—	30	260	*150*
Mix	—	—	.27	—	—	34	150	*38*
SHELL STRENGTH								
WL	—	—	.53	—	—	10	67	*184*
SHELL TEXTURE								
Mix	—	—	.27	—	—	34	150	*38*
SHELL DEFECTS								
WL's	.05	—	.08	—	—	464	3,036	*31*

TABLE 3.—*Reported heritability estimates of egg traits, by breed of chickens*—Continued

Trait of egg and breed of chicken	Heritability estimate					Degree of freedom		Ref.
	S	D	S+D	b_{OD}	Real.	S	D	
EGG SHAPE								
Light breeds:								
WL	.55	—	—	—	—	52	299	*29*
WL	—	—	.73	—	—	—	—	*69*
WL's	—	—	.39	—	—	40	—	*70*
WL*	.74±.10	—	—	—	—	340	1,200	*96*
WL	.61±.09	—	—	—	—	340	1,200	*96*
WL	−.04±.38	.51±.53	—	—	—	100	500	*207*
WL's	—	—	.22	—	—	12	117	*158*
WLX's	.27	—	.30	—	—	464	3,036	*31*
RIRXWL	.18±.37	.15±.46	—	—	—	100	500	*207*
WLXRIR	.16±.34	.32±.45	—	—	—	100	500	*207*
Average for light breeds	.35	.33	.41	—	—	—	—	—
Heavy breeds:								
NH	—	—	.56	—	—	—	—	*69*
RIR	.66±.53	.02±.55	—	—	—	100	500	*207*
WG*	.11	.09	.10	—	—	—	—	*55*
WG*	.51	.18	.35	—	—	—	—	*55*
WG*	.11	—	—	—	—	—	—	*86*
Syn	.28±.14	.26±.09	.27±.09	—	—	50	50	*151*
WG*	.29	.30	.30	—	—	50	50	*151*
——	.28	—	—	—	—	—	—	*99*
Average for heavy breeds	.32	.17	.32	—	—	—	—	—
YOLK COLOR								
WL	—	—	.05	—	—	10	67	*184*
Mix	—	—	.15	—	—	34	150	*38*
SHELL COLOR								
WL*	.48	.43	—	—	—	78	149	*56*
WL*	.17	.33	—	—	—	301	946	*56*
WL*	.54	.49	—	—	—	317	980	*56*
WL	.51±.19	.55±.15	.53±.10	—	—	20	179	*88*
WL	.37±.17	.72±.16	.54±.10	—	—	18	156	*88*
WL	.12±.08	.57±.12	.34±.06	—	—	18	180	*88*
WL	.54±.27	.63±.18	.58±.13	—	—	10	108	*88*
WLX's	.27	—	.33	—	—	464	3,036	*31*
RIR	.89±.22	.52±.11	.70±.10	—	—	26	245	*88*
S	.34±.14	.77±.21	.45±.11	—	—	12	144	*75*
S	.24±.17	.65±.20	.45±.11	—	—	12	144	*75*
S	.16±.12	.56±.15	.36±.08	—	—	12	144	*75*
S	.17±.12	.53±.15	.35±.08	—	—	12	144	*75*
S	.18±.10	.78±.14	.48±.07	—	—	22	194	*88*
Mix	.30	.91	—	.78	—	12	97	*12*
Mix	—	—	.58	—	—	34	150	*38*
——	.30±.11	.25±.14	.27±.09	—	—	50	50	*151*
——	.43	.34	.38	—	—	50	50	*151*
Average	.35	.56	.45	.78	—	—	—	—
MOTTLING								
WL*	−.01	.10	—	—	—	104	365	*93*
WL*	−.16	−.36	—	—	—	104	365	*93*
WL*	.00	.04	—	—	—	104	365	*93*

TABLE 3.—*Reported heritability estimates of egg traits, by breed of chickens*—Continued

Trait of egg and breed of chicken	Heritability estimate					Degree of freedom		Ref.
	S	D	S+D	b_{OD}	Real.	S	D	
HAUGH UNITS								
WL	.30	—	—	—	—	52	299	*33*
WL	—	—	—	.11	—	40	—	*70*
WL	.55±.20	.23±.13	.41±.11	—	—	20	179	*88*
WL	.54±.20	.43±.14	.48±.11	—	—	18	156	*88*
WL	.70±.23	.53±.11	.62±.11	—	—	18	180	*88*
WL	.68	.55	—	—	—	104	365	*93*
WL	—	—	.60±.15	—	—	30	260	*150*
WL	—	—	.21	—	—	—	—	*199*
WLX's	—	—	.32	—	—	—	—	*199*
WLXA	.57	—	—	—	—	45	208	*136*
WR	—	—	.37	—	—	64	380	*167*
WR	—	—	.43	—	—	32	192	*168*
WR's	—	—	.44	—	—	71	318	*205*
NH	.35	—	—	—	—	12	125	*49*
RIR	.47±.14	.34±.11	.40±.08	—	—	26	245	*88*
S	.50±.17	.55±.13	.52±.09	—	—	22	194	*88*
Syn	—.04±.03	.08±.07	.02±.08	—	—	50	50	*151*
Syn	—.05	.12	.04	—	—	50	50	*151*
Average	.42	.35	.37	.11	—	—	—	—
HAUGH UNITS — STORED								
2 weeks:								
WL	.66	.57	—	—	—	104	365	*93*
WLXA	.28	—	—	—	—	45	208	*136*
ALBUMEN SCORE								
WL	.29	—	—	—	—	52	299	*29*
WL*	.10	.71	—	—	—	104	365	*91*
WL*	.29	.40	—	—	—	300	1,500	*94*
WL*	.38±.09	—	—	—	—	340	1,200	*96*
WL*	.23±.09	—	—	—	—	340	1,200	*96*
WL	.67±.40	.21±.47	—	—	—	100	500	*207*
WL	—	—	.59	—	—	10	67	*184*
WL*	.25	.06	—	—	—	60	260	*186*
WLX's	.40	—	.42	—	—	464	3,036	*31*
RIRXWL	.08±.39	.15±.49	—	—	—	100	500	*207*
WLXRIR	.16±.38	.04±.45	—	—	—	100	500	*207*
RIR	.28±.10	—	—	—	—	478	1,700	*95*
RIR	.11±.51	.62±.56	—	—	—	100	500	*207*
Average	.27	.31	.51	—	—	—	—	—
ALBUMEN HEIGHT								
WL	.68±.22	.29±.13	.48±.11	—	—	20	179	*88*
WL	.56±.21	.48±.15	.52±.11	—	—	18	156	*88*
WL	—	—	.55	—	—	10	79	*90*
WL	—	—	.56±.14	—	—	30	260	*150*
WL	—	—	.36	—	—	—	—	*199*
WLX's	—	—	.23	—	—	—	—	*199*
BR	—	—	.55	—	—	10	76	*90*
WG*	.05	—	—	—	—	—	—	*86*
Mix	—	—	.22	—	—	34	150	*38*
Average	.43	.39	.43	—	—	—	—	—

TABLE 3.—*Reported heritability estimates of egg traits, by breed of chickens*—Continued

Trait of egg and breed of chicken	Heritability estimate					Degree of freedom		Ref.
	S	D	S+D	b_{OD}	Real.	S	D	
QUALITY LOSS								
Haugh units, 14 days:								
WL*	.22	.23	—	—	—	104	365	*93*
WL	.25	.58	—	—	—	50	250	*103*
Stored Haugh units/fresh Haugh units:								
WL	.28	.23	—	—	—	104	365	*93*
Albumen height loss, 12 days:								
WL	−.01	.04	—	—	—	20	173	*121*
WL	−.56	.18	—	—	—	20	165	*121*

TABLE 4.—*Reported heritability estimates of fertility, hatchability, mortality, aggressiveness, and physiological traits, by breed and sex of chickens*

Trait and breed of chicken	Sex	Heritability estimate					Degree of freedom		Ref.
		S	D	S+D	b_{OD}	Real.	S	D	
FERTILITY									
NH	♀	—	—	0.01	0.02±.04	—	43	79	*26*
NH	♀	0.02	0.21	.14	—	—	40	280	*47*
Inbreds	♀	—	—	—	.06	—	87	—	*194*
Average	—	.02	.21	.08	.04	—	—	—	—
HATCHABILITY									
All eggs-percent:									
NH	♀	.13	—	—	—	—	10	100	*20*
NH	♀	.04	—	—	.07±.04	—	43	79	*26*
Mix	♀	.11	—	—	—	—	—	—	*18*
NHXSO	♀	.11	—	—	—	—	10	100	*20*
SOXNH	♀	.08	—	—	—	—	10	100	*20*
Average	—	.09	—	—	.07	—	—	—	—
All eggs-probit:									
NH	♀	.27	—	—	—	—	10	100	*20*
SO	♀	.12	—	—	—	—	10	100	*20*
Mix	♀	.20	—	—	—	—	—	—	*18*
Mix	♀	.20	—	—	—	—	10	100	*20*
NHXSO	♀	.19	—	—	—	—	10	100	*20*
SOXNH	♀	.13	—	—	—	—	10	100	*20*
Average	—	.19	—	—	—	—	—	—	—

TABLE 4.—*Reported heritability estimates of fertility, hatchability, mortality, aggressiveness, and physiological traits, by breed and sex of chickens*—Continued

Trait and breed of chicken	Sex	Heritability estimate					Degree of freedom		Ref.
		S	D	S+D	b_{OD}	Real.	S	D	
HATCHABILITY—Con.									
Fertile eggs-percent:									
WL	♀	.16	.23	—	—	—	16	77	*24*
NH	♀	.06	—	—	—	—	10	100	*20*
NH	♀	.65	—	—	—	—	47	730	*27*
NH	♀	.29	—	—	—	—	47	730	*27*
NH	♀	.04	.22	.10	—	—	40	280	*47*
SO	♀	.12	—	—	—	—	10	100	*20*
Inbreds	♀	—	—	—	.16	—	84	396	*162*
Inbreds	♀	—	—	.02	—	—	87	813	*195*
NHXSO	♀	.04	—	—	—	—	10	100	*20*
SOXNH	♀	−.05	—	—	—	—	10	100	*20*
Mix	♀	.08	—	—	—	—	36	269	*71*
Mix	♀	.05	—	—	—	—	—	—	*18*
Average	—	.14	—	.06	.16	—	—	—	—
Fertile eggs-probit:									
NH	♀	.14	—	—	—	—	10	100	*20*
NH	♀	.02	—	—	.04±.04	—	43	79	*26*
SO	♀	.23	—	—	—	—	10	100	*20*
NHXSO	♀	.07	—	—	—	—	10	100	*20*
SOXNH	♀	−.14	—	—	—	—	10	100	*20*
Mix	♀	.08	—	—	—	—	—	—	*18*
Average	—	.07	—	—	.04	—	—	—	—
Fertile eggs at 30% hatch:									
WL	♀	.42	.57	—	—	—	16	77	*24*
Fertile eggs at 50% hatch:									
WL	♀	.36	.56	—	—	—	16	77	*24*
Fertile eggs at 70% hatch:									
WL	♀	.21	.51	—	—	—	16	77	*24*
HATCHING TIME									
WL	♀	.49	.58	—	—	—	16	77	*24*
MORTALITY									
Embryonic:									
1 week: Inbreds	C	—	—	.01	—	—	87	813	*195*
2 weeks: Inbreds	C	—	—	.01	—	—	87	813	*195*
3 weeks: Inbreds	C	—	—	.01	—	—	87	813	*195*
Growing:									
Chick: Inbreds	C	—	—	.05	—	—	87	813	*195*
0 to 3 weeks:									
WL	C	.03±.01	.36±.05	—	—	—	108	968	*134*
A	C	.02±.02	.37±.07	—	—	—	43	372	*134*
3 to 6 weeks:									
WL	C	.02±.02	.18±.04	—	—	—	108	968	*134*
A	C	.00±.00	.07±.07	—	—	—	43	372	*134*
0 to 6 weeks:									
WL	C	.03±.02	.28±.04	—	—	—	108	968	*134*
A	C	.01±.02	.36±.07	—	—	—	43	372	*134*
To 10 weeks: WL+X's	C	.02	—	.13	—	—	464	3,036	*31*
Average of growing mortality	—	.02	.27	.04	—	—	—	—	—

TABLE 4.—*Reported heritability estimates of fertility, hatchability, mortality, aggressiveness, and physiological traits, by breed and sex of chickens*—Continued

Trait and breed of chicken	Sex	Heritability estimate					Degree of freedom		Ref.
		S	D	S+D	b_{op}	Real.	S	D	
MORTALITY—Continued									
11 to 20 weeks: WL+X's	C	.02	—	.04	—	—	464	3,036	*31*
21 to 60 weeks: WL+X's	C	.05	—	.08	—	—	464	3,036	*31*
61 to 70 weeks: WL+X's	C	.00	—	.07	—	—	464	3,036	*31*
0 to 72 weeks: WL+X's	C	.05	—	.10	—	—	464	3,036	*31*
Annual:									
WL	♀	.08	—	.08	—	—	>100	—	*113*
——	♀	.08	.11	.09±.03	—	—	8	40	*154*
In laying house:									
WL+X's	♀	.08±.06	.27±.16	.10±.05	—	—	23	67	*60*
Mix	♀	.06	—	—	—	—	36	269	*71*
WLX's	♀	—	—	.05	—	—	—	—	*42*
Average annual	—	.08	.19	.08	—	—	—	—	—
From leucosis:									
WW	♀	.03±.04	.15±.14	.04±.04	—	—	23	67	*60*
WL	♀	.07	—	.08	—	—	>100	—	*113*
From lymphomatosis:									
S	♀	.00±.00	.04±.01	.01±.00	—	—	40	248	*141*
RIR	♀	.04±.02	.16±.05	.05±.02	—	—	46	281	*141*
——	♀	.05	.03	.05±.02	—	—	8	40	*154*
Resistance RIR	♀	.12	—	.22	—	—	9	135	*196*
Resistance RIR	♀	.14	—	.20	—	—	9	135	*196*
Resistance RIR	♀	.24	—	.12	—	—	9	135	*196*
Average	—	.09	.10	.10	—	—	—	—	—
From other diseases:									
WL	♀	.03	—	.03	—	—	>100	—	*113*
——	♀	.07	.06	.07±.02	—	—	8	40	*154*
From reproduction disorders	♀	.02	.06	.03±.02	—	—	8	40	*154*
LIVEABILITY									
Brooder: WW	C	.07±.01	.14±.01	.10±.01	—	—	54	363	*59*
To 10 weeks of age:									
Mix	C	.11	—	—	—	—	—	—	*18*
Mix	C	.20	—	—	—	—	—	—	*18*
Laying: Mix	♀	—	—	.12	—	—	—	—	*101*
To 365 days of age: RIR	♀	.03	—	—	—	—	42	48	*66*
To 72 weeks of age: WL	♀	.08	—	—	—	—	52	299	*29*
RESISTANCE TO ROUS SARCOMA VIRUS									
WC	—	.28	.78	—	—	—	13	59	*14*
J	C	—	—	.77	—	—	10	43	*152*
ADRENAL WEIGHT									
Left: WR	♂	—	—	.42	—	—	50	109	*172*
Right: WR	♂	—	—	.53	—	—	50	109	*172*
Both: WR	♂	—	—	.57	—	—	50	109	*172*

TABLE 4.—*Reported heritability estimates of fertility, hatchability, mortality, aggressiveness, and physiological traits, by breed and sex of chickens*—Continued

Trait and breed of chicken	Sex	Heritability estimate S	Heritability estimate D	Heritability estimate S+D	Heritability estimate b_{OD}	Heritability estimate Real.	Degree of freedom S	Degree of freedom D	Ref.
AGGRESSIVENESS									
Domination:									
WL	C	—	—	—	—	0.22	36	43	*57*
AC	♂	—	—	—	—	.57	—	—	*163*
WL	♀	—	—	—	—	—.27	—	—	*98*
WL	♀	—	—	—	—	.39	—	—	*98*
WL	♀	—	—	—	—	.70	—	—	*98*
WR	♀	—	—	—	—	.01	—	—	*98*
A	♀	—	—	—	—	.24	—	—	*98*
RIR	♀	—	—	—	—	.88	—	—	*98*
Average	—	—	.52	.33	—	.31	—	—	—
Encounters won: WL	C	—	—	—	—	.18	36	43	*57*
Matings completed:									
AC	♂	—	.52	.33	—	.18±.05	60	240	*169*
AC	♂	—	—	—	—	.31±.11	60	240	*169*
BLOOD									
Albumen, 8 weeks: WL, RIR	C	.60	—	—	—	—	12	159	*104*
Alkaline phosphatase:									
WL*	♀	—	—	—	.36	—	52	119	*192*
WL	♀	.40	.35	—	—	—	13	42	*181*
WL	♂	.03	.00	—	—	—	13	66	*181*
Alpha 1 globulin, 8 weeks: WL, RIR	C	.42	—	—	—	—	12	159	*104*
Alpha 2 globulin, 8 weeks: WL, RIR	C	.28	—	—	—	—	12	159	*104*
Alpha 3 globulin, 8 weeks: WL, RIR	C	.11	—	—	—	—	12	159	*104*
Beta+Gamma globulin, 8 weeks: WL, RIR	C	.58	—	—	—	—	12	159	*104*
Hemoglobin, 1 day: WL, RIR	C	.21	—	—	—	—	19	—	*104*
Hemoglobin, 2 weeks: ARB*	C	>1.0	—	—	—	—	19	—	*104*
Hemoglobin, 4 weeks: ARB*	C	.31	—	—	—	—	19	—	*104*
Hemoglobin, 6 weeks: ARB*	C	.36	—	—	—	—	19	—	*104*
Hemoglobin, 10 weeks: ARB*	C	.36	—	—	—	—	19	—	*104*
Hemoglobin, 12 weeks: ARB*	C	.83	—	—	—	—	19	—	*104*
Hemoglobin, 14 weeks: ARB*	C	.36	—	—	—	—	19	—	*104*
Hemoglobin, 17 weeks: ARB*	C	.16	—	—	—	—	19	—	*104*
Red blood cell volume	—	.39	.27	.35	.27	—	51	207	*188*
Carotinoid concentration									
Syn meat	♂	.21	.84	—	—	—	20	—	*179*
Syn meat	♀	.32	.54	—	—	—	20	—	*179*
Serum cholesterol, 6 weeks: WL*	♀	.34	.17	.25	—	—	52	116	*191*
Serum cholesterol, 9 weeks: WL	♀	.19	.41	.30	—	—	49	114	*22*
Pressure, mature:									
——	♂	—	—	—	—	.15	63	190	*180*
——	♀	—	—	—	—	.09	63	190	*180*
——	C	—	—	—	—	.13	63	190	*180*
Pressure, 19 weeks:									
WR	♂	—	—	.05	—	—	—	—	*189*
WR	♀	—	—	—.04	—	—	—	—	*189*
Protein, total: WL, RIR	C	.00	—	—	—	—	12	159	*104*
Prothrombin time:									
WR	♂	—	—	.53	—	.47	—	—	*132*
WR	♀	—	—	.03	—	.38	—	—	*132*

TABLE 4.—*Reported heritability estimates of fertility, hatchability, mortality, aggressiveness, and physiological traits, by breed and sex of chickens*—Continued

Trait and breed of chicken	Sex	Heritability estimate					Degree of freedom		Ref.
		S	D	S+D	b_{op}	Real.	S	D	
BURSA WEIGHT									
Hatching: WG	C	—	—	.32	—	—	—	—	*82*
11 days: WG	C	—	—	.48	—	—	—	—	*82*
27 days: WG*	C	.30	—	—	—	—	—	—	*54*
62 days: WR	♂	—	—	.33	—	—	50	109	*172*
COMB WEIGHT RESPONSE									
To testosterone propionate:									
High	—	—	—	—	.44±.08	—	—	160	*140*
Low	—	—	—	—	.27±.08	—	—	160	*140*
To Pregnant mare serum	—	—	—	—	.42±.11	—	—	160	*140*
HEAT TOLERANCE									
WL*	C	.44±.26	.47±.26	.45±.15	—	—	42	157	*193*
HEMAGGLUTINATION TITER									
For Newcastle virus: WL	C	—	—	.77	—	—	10	43	*152*
SEMEN VOLUME									
6 to 7 months:									
WR	♂	—	—	.14	—	—	64	380	*167*
WR	♂	.41±.30	—	—	—	—	24	—	*177*
SPERM CONCENTRATION									
WR	♂	.46±.30	—	—	—	—	24	—	*177*
WR	♂	—	—	.01	—	—	64	380	*167*
SPERM MOTILITY									
WR	♂	—	—	.29	—	—	64	380	*167*
WR	♂	.87±.40	—	—	—	—	24	—	*177*
SPLEEN WEIGHT									
1 day: WG*	C	—	—	.78	—	—	—	—	*54*
11 days: WG*	C	—	—	.50	—	—	—	—	*82*
27 days: WG*	C	.57	—	—	—	—	—	—	*82*
TESTES WEIGHT									
1 day: WG*	♂	—	—	.70	—	—	—	221	*84*
11 days: WG*	♂	—	—	.60	—	—	—	221	*84*
62 days: WG*	♂	—	—	−.18	—	—	50	109	*172*
11 weeks: NH	♂	.47	—	.43	—	—	8	66	*35*

TABLE 4.—*Reported heritability estimates of fertility, hatchability, mortality, aggressiveness, and physiological traits, by breed and sex of chickens*—Continued

Trait and breed of chicken	Sex	Heritability estimate					Degree of freedom		Ref.
		S	D	S+D	b_{OD}	Real.	S	D	
TESTES WEIGHT RESPONSE									
100 mg. LH injected: WR	♂	.24	—	—	—	—	8	—	*174*
200 mg. LH injected: WR	♂	—	—	.24	—	—	8	—	*174*
5 mg. FSH injected: WR	♂	0.00	—	—	—	—	5	—	*174*
10 mg. FSH injected: WR	♂	.04	—	—	—	—	5	—	*174*
20 mg. FSH injected: WR	♂	.16	—	—	—	—	5	—	*174*
64 mg. FSH injected: WR	♂	.64	—	—	—	—	5	—	*174*
THYROID WEIGHT									
4 weeks: NH	C	—	—	.92	—	—	5	74	*159*
62 days: WR	♂	—	—	.33	—	—	50	109	*172*
11 weeks:									
NH	♂	.04	—	.58	—	—	8	66	*35*
NH	♀	.07	—	.62	—	—	8	66	*35*
THYROXINE SECRETION									
2 to 15 weeks: NH	—	—	.68	—	1.18	.83	5	42	*178*
VISUAL STIMULUS RESPONSE									
24-hour chicks: WL	—	.59	.74	.66	—	—	4	15	*175*

Genetic and Phenotypic Correlations Estimates

The reported estimates of genetic and phenotypic correlations are summarized and reported in table 5. The number of estimates reported for many different traits is so large that it precludes the possibility of a reasonable discussion of all of them. In addition, as pointed out in the introduction, the estimates reported vary greatly. For this reason the discussion will be generalized and limited to those genetic correlations for which several estimates have been reported and for which a reasonable estimate of the average can be given.

Body weights taken before sexual maturity show a rather high positive genetic correlation with mature body weights (in the range of 0.52 to 0.68); a positive correlation with pullet egg weight (0.15) and with mature egg weight (0.37); and a small negative correlation with sexual maturity (−0.10), measures of egg production (short-term) (−0.12), and specific gravity (−0.03).

Pullet body weights are positively correlated with both pullet and mature egg weights (0.34 and 0.40), page 34, as are mature body weight (0.29 and 0.36), page 34.

Most estimates of the genetic correlation between sexual maturity and different measures of production are negative but range from −0.96 to +0.58. The correlation of sexual maturity with egg weight is small and positive (0.06 to 0.08), whereas the correlation of sexual maturity with specific gravity is quite high (0.29).

When all measures of egg production are considered, an average of genetic correlations between the traits indicates that egg production shows a small negative correlation with egg weight (about −0.05) but considerably larger negative correlations with Haugh units (about −0.33), specific gravity (about −0.31), and shell thickness (about −0.26).

Egg weight is negatively correlated with albumen quality of pullet eggs (−0.32) and positively correlated with albumen height of eggs of mature hens (0.26); with fresh Haugh units for eggs of mature hens (0.04); and with average specific gravity (0.13) and average shape of eggs of pullets and mature hens (0.19).

Albumen quality shows small negative correlations with specific gravity and egg shape (−0.04 and −0.07). Specific gravity appears to be positively correlated with egg shape (0.12).

TABLE 5.—*Reported estimates of genetic and phenotypic correlations among traits in chickens, by age of chickens*

Traits correlated	Correlation: Genetic	Correlation: Phenotypic	Ref.
BODY WEIGHT			
3 weeks and—			
6 weeks	0.91	0.83	*126*
9 weeks	.83	.74	*126*
12 weeks	.70	.68	*126*
4 weeks and—			
8 weeks	.84	.93	*168*
8-week breast angle	.22	—	*167*
Cumulative number of matings	.31	.07	*169*
6 weeks and—			
9 weeks	.95	.93	*126, 129, 130*
12 weeks	.92	.62	*125, 126*
9-week breast angle	.16	—	*129*
9-week keel length	.71	—	*129*
9-week shank length	.77	—	*129*
Serum cholesterol level at 6 weeks	—	—.09	*191*
8 weeks and—			
Pullet body weight	.68	.56	*81, 95, 96, 168, 203*
Mature body weight	.52	.43	*41, 45, 81, 86, 95, 96, 145, 168, 203*
8-week feather score	.51	.39	*79*
8-week breast angle	.28	.35	*164, 173*
Age at first egg	—.10	.07	*81, 94, 96, 97, 168, 203*
Rate of production:			
Short term	—.12	—.07	*41, 81, 95, 96, 97, 168, 203, 207*
34 to 64 weeks of age	.65	—.02	*203*
41 to 55 weeks of age	.14	—	*96*
56 to 70 weeks of age	.01	—	*96*
64 weeks of age	—.76	—.04	*203*
70 weeks of age	.11	—	*95, 96*
Survivor production:			
To 8 months of age	.05	—	*117*
To 46 weeks of age	.15	—.07	*86*
To 500 days of age	.09	—.02	*62*
Pullet egg weight	.15	.11	*95, 96, 203*
Mature egg weight	.37	.21	*45, 81, 95, 96, 97, 168, 203*
Haugh units	.12	.32	*168*
Albumen height	.13	.02	*86*
Albumen quality—			
USDA score	—.21	—	*95, 96*
Specific gravity	—.03	—.08	*95, 96, 168*
Shape index	.23	—	*95, 96*
Aggressiveness	.34	.39	*173*
Semen volume	.21	.51	*168*
Sperm concentration	—.16	—1.05	*168*
Sperm motility	—.29	—.36	*168*
Number of matings	.07	—.01	*169*
Serum cholesterol level at 6 weeks	—.37	.00	*191*
BODY WEIGHT—Con.			
8 weeks and—Continued			
Shank pigmentation at 8 weeks	—.54	—.07	*202*
9 weeks and—			
12 weeks	.98	.93	*126*
Pullet body weight	.69	.58	*62, 130*
Mature body weight	.62	—	*130*
9-week breast angle	.33	.31	*48, 130*
308-day breast angle	.20	—	*102*
308-day keel length	.73	—	*102*
9-week shank length	.79	—	*102*
308-day shank length	.83	—	*103*
Age at first egg	—.05	—.26	*62, 130*
Hen housed production—annual	.09	—	*130*
Mature egg weight	.17	.38	*62, 130*
62-day adrenal weight	—.37	—.47	*172*
62-day bursa weight	.18	.07	*172*
62-day thyroid weight	—.33	.26	*172*
Semen concentration at 6 to 7 months	.04	—	*177*
Sperm motility at 6 to 7 months	—.21	—	*177*
Semen quantity at 6 to 7 months	.08	—	*177*
10 weeks and—			
Mature body weight	.78	.40	*127*
10-week breast angle	.65	.16	*11*
Age at first egg	.35	—.18	*101, 149*
Survivor production to 319 days >S.M.	.13	—	*101*
Persistency	.26	—	*101*
11-week thyroid weight	.68	.58	*35*
11-week testes weight	.35	.40	*35*
12 weeks and—			
Pullet body weight	.79	—	*23*
Mature body weight	.65	—	*23*
12-week breast width	.16	.13	*3, 34, 106*
12-week keel length	.74	.80	*3, 106*
12-week shank length	.87	.66	*3, 106*
Age at first egg	—.26	—.03	*23, 125*
Pullet egg weight	.25	—	*23*
Mature egg weight	.32	.12	*23, 125*
Survivor production:			
To 28 weeks of age	.22	—	*23*
28 to 36 weeks of age	.08	—	*23*
36 to 44 weeks of age	—.06	—	*23*
To 46 weeks of age	—.20	—	*34*
Annual	.11	—	*23*
Hen housed production to 46 weeks of age	—.17	—	*34*
Rate of production—annual	—	.03	*125*
Pullet and—			
Mature body weight	.91	.43	*23, 95, 96, 197, 203*
8-week breast angle	.15	.18	*167*

TABLE 5.—*Reported estimates of genetic and phenotypic correlations among traits in chickens, by age of chickens*—Continued

Traits correlated	Correlation		Ref.
	Genetic	Phenotypic	
BODY WEIGHT—Con.			
Pullet and—Continued			
Age at first egg	.03	−.17	*7, 23, 30, 62, 63, 68, 95, 96, 203*
Survivor production:			
To 250 days of age	.06	—	*63*
To 28 weeks of age	.10	—	*23*
28 to 36 weeks of age	.05	—	*23*
36 to 44 weeks of age	−.03	—	*23*
To 46 weeks of age	.09	.03	*86*
250 to 450 days	−.30	—	*63*
To 450 days	−.16	—	*63*
Annual	.06	—	*23*
Rate of production:			
Short term	−.15	.01	*95, 96, 203*
Dec. 1 to March 1	.68	—	*197*
March 2 to May 31	.54	—	*197*
34 to 64 weeks of age	−.58	−.05	*203*
41 to 55 weeks of age	.15	—	*96*
56 to 70 weeks of age	−.09	—	*96*
To May 31	.56	—	*197*
To 64 weeks of age	−.16	−.03	*203*
To 70 weeks of age	−.09	—	*95, 96*
Pullet egg weight	.34	.25	*7, 23, 40, 95, 96, 203*
Mature egg weight	.40	.17	*23, 30, 62, 63, 86, 95, 96, 197, 203*
Albumen quality—			
USDA score	−.05	—	*95, 96*
Albumen height	−.05	.05	*86*
Specific gravity	−.02	—	*95, 96*
Shape index	.06	−.01	*86, 95, 96*
Persistency	.67	—	*7*
Mating frequency	.17	−.01	*169*
Mature and—			
8-week breast angle	.13	.16	*167*
Age at first egg	.06	.12	*7, 23, 89, 91, 95, 96, 101, 149, 161, 203*
Survivor production:			
1 month	−.29	−.12	*89*
2 months	−.43	−.08	*89*
3 months	−.42	−.06	*89*
28 weeks	.06	—	*23*
28 to 36 weeks of age	.01	—	*23*
36 to 44 weeks of age	.09	—	*23*
Short term	−.51	−.10	*89*
To 11 months of age	−.01	.06	*23, 88*
To 319 day>maturity	.07	—	*101*
Annual	.03	.11	*89, 161*
Hen housed production to 44 weeks of age	.12	−.11	*78*
Rate of production:			
Dec. 1 to Mar. 1	−.31	—	*197*
Mar. 2 to May 31	.71	—	*197*
Short term	.00	.05	*41, 91, 95, 96, 203, 207*
BODY WEIGHT—Con.			
Mature and—Continued			
Rate of production—Continued			
34 to 64 weeks of age	−.44	−.04	*203*
41 to 55 weeks of age	−.04	—	*96*
56 to 70 weeks of age	.00	—	*96*
Winter	−.12	−.03	*72*
64 weeks of age	−.06	−.05	*203*
To 70 weeks of age	−.11	—	*95, 96*
Annual	.16	.17	*91*
Persistency	.16	—	*101*
Pullet egg weight	.29	.08	*23, 95, 96, 161, 203*
Mature egg weight	.36	.23	*23, 41, 45, 72, 78, 88, 89, 91, 95, 96, 142, 145, 197, 203*
Albumen quality—			
USDA score	−.03	—	*95, 96, 207*
Albumen height	.06	.12	*88*
Haugh units	.01	.16	*88*
Haugh units—fresh	.17	.28	*93*
Haugh units—stored	−.13	−.93	*93*
Haugh unit loss in 2 weeks	.69	.26	*93*
Specific gravity	.09	−.01	*88, 95, 96*
Shape index	.05	—	*95, 96*
Shell color	−.06	−.03	*88*
Serum cholesterol level:			
At 6 weeks	−.37	−.03	*191*
At 8 months	—	−.02	*191*
WEIGHT GAIN			
0 to 3 weeks and—			
3 to 6 weeks	.87	.39	*44*
6 to 9 weeks	—	.22	*44*
9 to 12 weeks	−.20	.09	*44*
3 to 6 weeks and—			
6 to 9 weeks	—	.25	*44*
9 to 12 weeks	.47	.24	*44*
6 to 9 weeks and—			
9 to 12 weeks	−.48	.01	*44*
FEATHERING			
10-day back and—			
10-day breast feathering	—	.53	*170*
5-week back feathering	—	.28	*170*
7-week back feathering	—	.28	*170*
10-week pinfeathers	—	−.08	*170*
10-week down score	—	−.12	*170*
10-day breast and—			
5-week back feathering	—	.30	*170*
7-week back feathering	—	.29	*170*
10-week pinfeathers	—	−.17	*170*
10-week down score	—	−.09	*170*
5-week back and—			
10-week pinfeathers	—	−.10	*170*
10-week down score	—	−.21	*170*

TABLE 5.—*Reported estimates of genetic and phenotypic correlations among traits in chickens, by age of chickens*—Continued

Traits correlated	Correlation		Ref.
	Genetic	Phenotypic	
FEATHERING—Con.			
7-week back and—			
10-week pinfeathers	—	−.23	*170*
10-week down score	—	−.29	*170*
10-week pinfeathers and—			
10-week down score	—	.13	*170*
Breast feathering and—			
Breast blisters in broilers	.50	.70	*58*
BREAST ANGLE			
8-week and—			
59-day live weight	.27	.38	*171*
59-day eviscerated weight	.06	.38	*171*
8-week feathering	.08	.07	*167*
Age at first egg	.04	.01	*167*
Rate of production—annual	.02	−.02	*167*
Mature egg weight	.11	.16	*167*
Haugh unit loss in 2 weeks	.00	.04	*167*
Specific gravity	−.32	−.15	*167*
Semen volume	.15	.13	*167*
Sperm concentration	.86	.22	*167*
Sperm motility	.35	.27	*167*
Number of matings	−.12	−.01	*169*
9-week and—			
Broiler weight	.21	—	*131*
9-week keel length	.22	—	*129, 131*
9-week shank length	−.12	—	*129, 131*
12-week breast width and—			
12-week shank length	.35	.38	*3, 106*
KEEL LENGTH			
12-week and—			
12-week shank length	.55	.52	*3, 106*
12-week breast width	−.35	−.07	*3, 106*
SEXUAL MATURITY			
Age at first egg and—			
Survivor production:			
To 28 weeks of age	−.96	—	*23*
28 to 36 weeks of age	−.32	—	*23*
36 to 44 weeks of age	−.10	—	*23*
To 44 weeks of age	−.58	—	*23*
To 46 weeks of age	−.58	—	*34*
Winter	−.72	—	*2*
Short term	−.59	−.48	*17, 34, 63*
To 500 days of age	−.65	—	*7*
Annual	−.23	−.20	*17, 30, 39, 63, 89, 101, 161*
Hen housed production:			
To 46 weeks of age	−.22	—	*34*
Short term	−.62	−.34	*185*

Traits correlated	Correlation		Ref.
	Genetic	Phenotypic	
SEXUAL MATURITY—Continued			
Age of first egg and—Con.			
Rate of production:			
Short term	−.79	−.10	*46, 91, 95, 96, 97, 203, 207*
34 to 64 weeks of age	−.34	.01	*203*
41 to 55 weeks of age	−.04	—	*96*
56 to 70 weeks of age	−.03	—	*96*
To 60 weeks of age	−.33	—	*30*
To 64 weeks of age	.58	−.07	*203*
To 70 weeks of age	.04	—	*95, 96*
Annual	−.50	.27	*91, 92*
Pullet egg weight	.06	−.23	*7, 23, 95, 96, 161*
Mature egg weight	.10	−.01	*2, 7, 23, 39, 89, 95, 96, 203*
Albumen quality—			
USDA score	.00	—	*30, 95, 96*
Haugh units—fresh	.37	.32	*93*
Haugh units—stored 2 weeks	.35	.31	*93*
Haugh units loss in 2 weeks	−.09	.04	*93*
Specific gravity	.29	—	*95, 96*
Egg Shape	.16	—	*95, 96*
Percent blood spots	−.10	.02	*39*
Serum cholesterol level:			
At 6 weeks	.33	.04	*191*
At 8 months	—	−.02	*191*
Persistency	−.15	—	*7*
SURVIVOR PRODUCTION			
To 28 weeks of age and—			
28 to 36 weeks of age	.43	—	*23*
36 to 44 weeks of age	.20	—	*23*
To 44 weeks of age	.70	—	*23*
Pullet egg weight	.17	—	*23*
Mature egg weight	−.04	—	*23*
28 to 36 weeks of age and—			
36 to 44 weeks of age	.67	—	*23*
To 44 weeks of age	.86	—	*23*
Pullet egg weight	.27	—	*23*
Mature egg weight	−.31	—	*23*
36 to 44 weeks of age and—			
To 44 weeks of age	.80	—	*23*
Pullet egg weight	.13	—	*23*
Mature egg weight	−.15	—	*23*
Short term and—			
400 to 450 days of age	.77	—	*63*
300-day production	.56	.42	*146*
Too 500 days of age	.67	.50	*146*
Annual	.43	.55	*17, 107, 146*
Rate of production—short term	.30	.22	*146*
Egg mass to January	.91	.94	*187*
Pullet egg weight	.24	—	*23*
Mature egg weight	−.15	−.04	*23, 29, 63, 69, 78, 89, 187*

TABLE 5.—*Reported estimates of genetic and phenotypic correlations among traits in chickens, by age of chickens*—Continued

Traits correlated	Correlation Genetic	Correlation Phenotypic	Ref.
SURVIVOR PRODUCTION—Continued			
Short term and—Con.			
Albumen quality—USDA score	−.20	−.22	*29*
Specific gravity	.09	−.30	*29*
Egg shape	−.29	−.07	*29, 69*
Annual and—			
Winter	.85	.73	*29*
To 500 days of age	.96	.94	*146*
Annual	.73	.61	*146*
Rate of production to 60 weeks of age	.83	—	*30*
Pauses >6 days	.59	—	*101*
Pauses <6 days	−.59	—	*101*
Persistency	.38	—	*101*
Pullet egg weight	−.02	−.11	*161*
Mature egg weight	−.04	−.03	*7, 29, 62, 63, 69, 88, 89, 150, 187*
Percent blood spots	.08	.03	*39*
Percent meat spots	.01	—	*118*
Albumen quality—USDA score	−.37	−.14	*29, 150, 184*
Albumen height	−.04	−.02	*88*
Haugh units	−.28	−.21	*50, 88, 139, 150*
Specific gravity	−.30	−.13	*29, 88, 136*
Shell thickness	−.26	−.05	*50, 150, 184*
Egg shape	−.18	−.05	*29, 69*
Yolk color	−.21	—	*184*
Viability	.67	—	*101*
Serum cholesterol level at 6 weeks	.37	−.06	*191*
Serum alkaline phosphatase	.50	.01	*192*
HEN HOUSED PRODUCTION			
Short term and—			
First month	.69	.35	*185*
Second month	.69	.93	*185*
Third month	.89	.78	*185*
Annual	1.21	.65	*185*
RATE OF PRODUCTION			
34 to 64 weeks of age and—			
To 64 weeks of age	.58	.01	*203*
41 to 55 weeks of age and—			
56 to 70 weeks of age	.88	—	*96*
Annual	.87	—	*96*
Short term and—			
34 to 64 weeks of age	.67	.05	*203*
41 to 55 weeks of age	.76	—	*96*
56 to 70 weeks of age	.45	—	*96*
To 64 weeks of age	.19	−.04	*203*
RATE OF PRODUCTION—Continued			
Short term and—Con.			
Annual	.90	—	*95, 96*
Pullet egg weight	.45	−.10	*203*
Mature egg weight	−.03	.01	*91, 203, 207*
Albumen quality—USDA score	.08	—	*95, 96, 207*
Specific gravity	−.41	—	*95, 96, 207*
Shape index	−.10	—	*95, 96, 207*
Annual and—			
Rate of production to 60 weeks of age	.91	—	*30*
Mature egg weight	.01	.11	*91*
Albumen quality—USDA score	.00	.02	*91, 94, 96*
Haugh units—fresh	−.38	.03	*93*
Haugh units—stored 2 weeks	−.50	.77	*93*
Haugh unit loss in 2 weeks	.36	.07	*93*
Specific gravity	−.23	—	*94, 96*
Shape index	.17	—	*94, 96*
Persistency	.65	—	*7*
EGG WEIGHT			
Pullet and—			
Rate or production:			
34 to 64 weeks of age	−.04	.04	*203*
41 to 55 weeks of age	−.17	—	*96*
56 to 70 weeks of age	−.09	—	*96*
Short term	−.49	—	*95, 96, 151*
To 64 weeks of age	−.23	−.04	*203*
Annual	−.42	—	*95, 96*
Mature egg weight	.83	.29	*7, 23, 95, 96, 203*
Albumen quality—USDA score	−.32	—	*95, 96*
Specific gravity	.09	—	*95, 96*
Mature and—			
Survivor production:			
To 46 weeks of age	−.16	.01	*86*
Winter	−.38	—	*2*
Rate of production:			
34 to 64 weeks of age	.07	.02	*203*
41 to 55 weeks of age	−.20	—	*96*
56 to 70 weeks of age	−.37	—	*96*
Short term	−.31	—	*95, 96, 207*
To 64 weeks of age	.09	−.05	*203*
Annual	−.36	—	*95, 96*
Albumen quality—USDA score	.14	.05	*29, 30, 95, 96, 136*
Albumen height	.26	.31	*86, 88, 150, 199*
Haugh units	−.04	−.05	*88*
Haugh units—fresh	.04	.22	*93, 150, 199*
Haugh units—stored 2 weeks	.02	.34	*93*

TABLE 5.—*Reported estimates of genetic and phenotypic correlations among traits in chickens, by age of chickens*—Continued

Traits correlated	Correlation: Genetic	Correlation: Phenotypic	Ref.
EGG WEIGHT—Con.			
Mature and—Continued			
Haugh unit loss in 2 weeks	.79	.43	*93*
Specific gravity	.16	.00	*29, 88, 95, 96, 136*
Shell thickness	.25	.24	*150*
Percent blood spots	—.04	.00	*39*
Percent meat spots	—.04	—	*118*
Egg shape	.07	.06	*29, 69, 86, 95, 96*
Shell color	—.02	—.06	*76, 88*
Yolk weight	.83	.55	*63*
Yolk weight/egg weight	—1.00	—.42	*63*
Serum cholesterol level:			
At 6 weeks	—.35	—.07	*191*
At 8 months	—	—.18	*191*
BLOOD SPOTS			
Percent and—			
Rate of production to 60 weeks of age	—.13	—	*30*
Shell thickness	.44	—	*115*
Serum cholesterol level at 6 weeks	.00	—.05	*191*
MEAT SPOTS			
Percent and—			
Shell thickness	—.43	—	*118*
Serum cholesterol level at 6 weeks	.00	.08	*191*
ALBUMEN			
Quality and—			
Rate of production:			
41 to 55 weeks of age	.00	—	*96*
56 to 70 weeks of age	—.48	—	*96*
Albumen quality—stored	.94	.74	*136*
Specific gravity	—.04	.17	*29, 95, 96, 131*
Egg shape	—.07	—.12	*29, 30, 95, 96*
Serum cholesterol level at 6 weeks	.23	—.04	*191*
Height and—			
Survivor production:			
In March	—.13	—.24	*199*
To 46 weeks of age	.00	—.03	*86*
Percent meat spots	—.16	—	*118*
Haugh units	.96	.94	*88, 199*
Specific gravity	—.37	—.27	*90*
Shell thickness	.14	.15	*150, 199*
Egg shape	.20	.20	*86*
Hatching date	.13	.08	*199*
Haugh units and—			
Survivor production in March	—.24	—.23	*199*
Percent meat spots	—.19	—	*118*
Albumen quality—USDA score	—.85	—.55	*93*
ALBUMEN—Continued			
Haugh units and—Con.			
Haugh units—stored 2 weeks	.96	—	*116*
Shell thickness	.18	.11	*50, 199*
Specific gravity	.21	.07	*88*
Shell color	—.01	—.06	*88*
Percent hatch:			
Of fertile eggs	.45	—.03	*50*
Of all eggs	—.39	—.03	*50*
Hatching date	—.23	—.19	*199*
Serum cholesterol level:			
At 6 weeks	—	—.05	*191*
At 8 months	—	—.23	*191*
Haugh unit loss in 2 weeks and—			
Albumen quality—USDA score	—.14	.02	*93*
Haugh units—fresh	—.15	.36	*93*
Haugh units—stored 2 weeks	—.38	—.42	*93*
Haugh units—stored/Haugh units—fresh	—.89	—.96	*93*
SHELL QUALITY			
Specific gravity and—			
Rate of production:			
41 to 55 weeks	—.44	—	*96*
56 to 70 weeks	—.25	—	*96*
Egg shape	.12	.03	*29, 95, 96*
Shell color	—.09	—.04	*88*
Shell thickness and—			
Percent hatch:			
Of fertile eggs	—.13	.05	*50*
Of all eggs	—.20	.08	*50*
Shell strength and—			
Serum cholesterol level:			
At 6 weeks	.00	.08	*191*
At 8 months	—	—.02	*191*
Egg shape and—			
Survivor production to 46 weeks	.12	.07	*86*
Rate of production:			
41 to 55 weeks	.37	—	*96*
56 to 70 weeks	.25	—	*96*
HATCHABILITY			
Percent hatch of fertile eggs and—			
Survivor production—October to July	.30	.16	*71*
Hen housed production—October to July	.23	.25	*71*
Hen day production—October to July	.31	.13	*71*
Current egg production	.96	.05	*25*
Weeks in production	.22	.04	*25*
Weeks of age	—	.06	*25*
Percent inbreeding	—	.01	*25*
Fertility	.36	.18	*26, 145*
Percent hatch of all eggs	—	.78	*26*

TABLE 5.—*Reported estimates of genetic and phenotypic correlations among traits in chickens, by age of chickens*—Continued

Traits correlated	Correlation: Genetic	Correlation: Phenotypic	Ref.
HATCHABILITY—Con.			
Percent hatch of all eggs set and—			
Fertility	—	.69	*26*
COMB WEIGHT			
Single and—			
Testes weight	−.03	.07	*84*
THYROID			
Weight and—			
11-week testes weight	.40	.37	*35*
62-day adrenal weight	−.09	−.02	*172*
62-day bursa weight	−.25	−.00	*172*
BURSA			
62-day weight and—			
62-day adrenal weight	−.18	−.05	*172*
MATINGS			
Number of completed and—			
Number of courts	.36	.54	*204*
Number of courts	.36	.60	*169*
Number of mounts	.71	.94	*169*
Number of treads	.82	.97	*169*
Relative aggressiveness	.08	.09	*169*
Number of normal approaches	—	.91	*204*
Number of abnormal approaches	—	.30	*204*
Semen appearance score	—	.13	*204*
1. Sperm motility	.23	.03	*204*
2. Sperm motility	.23	.01	*169*
3. Semen volume	−.38	.07	*204*
4. Semen volume	−.38	−.04	*169*
5. Sperm concentration	—	.15	*204*
6. Sperm concentration	−.67	.01	*169*
Number of crouches	—	.68	*204*
Mild avoidances	—	.48	*204*
Strong avoidances	—	.23	*204*
Percent fertility	—	.35	*204*
COURTS			
Number and—			
Number of normal approaches	—	.44	*204*
Number of abnormal approaches	—	.17	*204*
Number of crouches	—	.59	*204*
Mild avoidances	—	.94	*204*
Strong avoidances	—	.43	*204*
APPROACHES			
Number of normal and—			
Number of abnormal approaches	—	.22	*204*
Number of crouches	—	.63	*204*
Mild avoidances	—	.44	*204*
Strong avoidances	—	.39	*204*
APPROACHES—Con.			
Number of abnormal and—			
Number of crouches	—	.25	*204*
Mild avoidances	—	.12	*204*
Strong avoidances	—	.26	*204*
CROUCHES			
Number and—			
Mild avoidances	—	.51	*204*
Strong avoidances	—	.16	*204*
SEMEN			
Appearance score and—			
Motility score	—	.59	*204*
Volume	—	.21	*204*
Optical density	—	.87	*204*
Sperm count	—	.39	*204*
Percent fertility	—	.22	*204*
Volume and—			
Optical density score	—	.26	*204*
Sperm motility	.04	—	*177*
Sperm count	—	.12	*204*
Percent fertility	—	.15	*204*
Optical density and—			
Sperm count	—	.48	*204*
Percent fertility	—	.20	*204*
Quantity and—			
Sperm concentration	−.04	—	*177*
Sperm motility	.04	—	*177*
SPERM			
Motility and—			
Volume	—	.12	*204*
Optical density	—	.57	*204*
Sperm count	−.04	.38	*177, 204*
Percent fertility	—	.31	*204*
Count and—			
Sperm motility	.51	—	*177*
Percent fertility	—	.04	*204*
Concentration and—			
Sperm motility	.51	—	*177*
MORTALITY			
Adult and—			
Hen housed production—October to July	−.56	−.22	*71*
Hen day production—October to July	−.27	−.67	*71*
Hen day production to 365 days >S.M.	.42	.14	*144*
Total leucosis mortality	.90	—	*113*
Total nonleucosis mortality	.83	—	*113*
Total mortality	.54	—	*113*
Broodiness	.03	.11	*145*
Percent hatch of fertiles	−.33	−.05	*71*

GENERAL CONCLUSIONS

The extreme variability of reported estimates is perhaps one of the most obvious features of a summary of reported heritability and of genetic or phenotypic correlation estimates. Standard errors of estimates are usually large, even where estimates are made from large populations. For this reason, the value of estimates of these parameters in a specific population is questionable to one interested in a genetically different population.

Another feature that is obvious from a review of the literature on genetic parameter estimates is lack of information regarding the importance of genotype environment interactions and maternal, dominance, epistatic, or other effects that may or may not be important in the genetic study of various traits. These effects have been expeditiously handled in many cases simply by assuming that they are negligible or do not exist. It seems that more studies designed to estimate the importance of these effects would be well justified.

It seems reasonable to conclude that sufficient estimates of the heritability of body weights, egg weights, sexual maturity, and measures of egg production have been reported so that averages provide meaningful estimates of expected values of this parameter. For most other traits reported estimates are too few to provide meaningful approximations of the heritability. Additional estimates would be of some value. However, it does not seem that studies designed to estimate heritability are justified unless they are a byproduct of a selection experiment or some other genetic study.

For reasons discussed earlier, individual estimates of genetic or phenotypic correlations are of little value except as they relate to a specific genetic study. If a very large number of these are reported for any two traits, averages would provide an expected value for the parameters but these approximations would be quite unreliable. Thus, although reported estimates of genetic or phenotypic correlations are of some general interest, they are of principal value as they relate to specific populations and should be recognized as such.

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